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Journal of the AMERICAN STATISTICAL ASSOCIATION

CONTENTS *for* JUNE 1944

The Inter American Statistical Institute: Four Years Old	*Stuart A. Rice*	135
War Time Facts and Peace Time Needs	*Vergil D. Reed*	144
Centralized Internal Control of Data Collection by Federal Agencies	*Edward T. Crowder*	155
Methods Used in Processing Data from the Physical Examination Reports of the Selective Service System	*Thomas I. Edwards* and *Louis P. Hellman*	165
Benefits and Beneficiaries under Social Insurance and Related Programs	*Franklin M. Aaronson*	183
Use of the Survival Rate Method in Measuring Net Migration	*C. Horace Hamilton* and *F. M. Henderson*	197
The Rising Liquidity of Manufacturing Companies and Its Implications for Financing Postwar Conversion	*Frederick C. Dirks*	207
The Concept of Productive Activity	*Irving H. Siegel*	218
Some Problems of Statistical Education and Teaching	*Juan Kimelman*	229
On Samples from Finite Populations	*Jerome Cornfield*	236
A Simplified Formula for Mean Difference	*Tseng-Tung Cheng*	240
A New Probability Function and Its Properties	*Tseng-Tung Cheng*	243
A Chart of the Chi-Square Distribution	*C. I. Bliss*	246
Notes and Discussions		249
Book Reviews		255

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Incorporated 1841

The American Statistical Association is a scientific and educational organization. Its membership is not confined to professional statisticians but includes economists, business executives, research directors, government officials, university professors, and other persons who are seriously interested in the application of statistical methods to practical problems, in the development of more useful methods, and in the improvement of basic statistical data. Engineers, mathematicians, biologists, actuaries, sociologists, psychologists, and representatives of many other professions are included in the membership of the Association. Information about the Association and membership application forms may be secured from the Secretary, Lester S. Kellogg, 1603 K Street, N. W., Washington 6, D. C.

Chapters of the Association have been organized in important cities in the United States and in Havana, Cuba. Information concerning the meetings of these Chapters may be secured from the District Representatives listed on another page.

The Editors welcome the submission of articles and notes for possible publication in the JOURNAL. Manuscripts should be sent to the Editor, Journal of the American Statistical Association, 1603 K Street, N. W., Washington 6, D. C. Books for review should be sent to the Review Editor, Glenn E. McLaughlin, 1603 K Street, N. W., Washington 6, D. C. Authors who wish suggestions about the preparation of manuscripts and charts or information about editorial policies should address their inquiries to the Editor.

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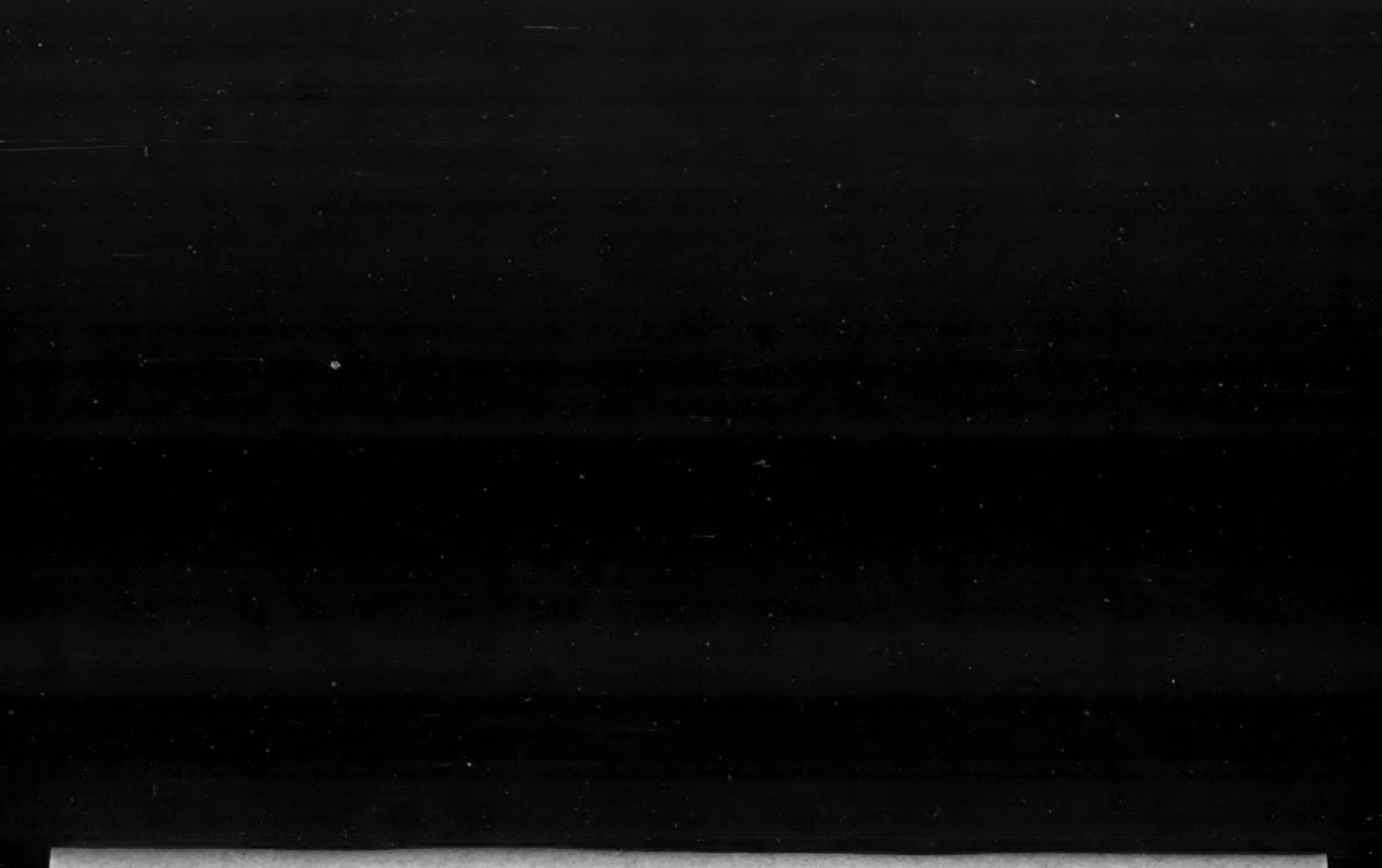

JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

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THE INTER AMERICAN STATISTICAL INSTITUTE: FOUR YEARS OLD

By Stuart A. Rice
First Vice President IASI, U. S. Bureau of the Budget

PARENTAGE

For more than half a century before the present war the world-wide honor society known as the International Statistical Institute upheld with dignity the conception of internationalism in statistical science and practice.[1] While its influence beyond question was real and wholesome, this influence was more passive than dynamic and was confined to areas of the world which already possessed a well-developed statistical tradition. These, in general, were Europe west of Russia and America north of the Rio Grande. Members from other areas were few in number and significant contributions by the Institute to statistical developments within them were almost completely lacking. Among the 215 members in 1939, only 6 were accredited to Latin American countries: 1 to Argentina, 3 to Brazil and 2 to Mexico. Yet it was precisely in the vigorous young nations of Latin America that aggressive stimulation of an awakening statistical interest was most likely to produce rapid statistical progress.

In this setting it is easy to see that formation of the Inter American Statistical Institute in no way reflected an abstract conception of political or economic regionalism. It merely reflected the limitations of its parent organization, the ISI, as a positive instrument for the development of statistical traditions in a major world area where these were lacking and greatly needed.

It is possible that except for the outbreak of World War II, the parent body would have been converted into a vital force for statistical progress in all parts of the world. North American delegates at the 24th biennial session in Prague in September, 1938, suggested the likelihood of regional separatism in the continued absence of genuine internationalism within the International Statistical Institute. Subsequent

[1] Whether the ISI has maintained an organized existence on the continent of Europe during the War is not known here.

proposals by Julin, Institute president, would have permitted an autonomous statistical program for the western hemisphere within the structure of the parent organization. Consideration of his plan was forestalled by world events which compelled their forecast of separatism to be taken seriously by those who made it and actually to be carried out. Nevertheless, the founding members of the Inter American Statistical Institute were and are convinced that worldwide scientific collaboration is desirable in the field of statistics as elsewhere; and the Statutes which they prepared for the new organization leave open the way for an ultimate reaffiliation with its global forebear.

The birth date of the new Institute may conveniently be recorded as May 12, 1940. On that day 12 members of the International Statistical Institute from Argentina, Canada, Mexico and the United States met at the Cosmos Club in Washington during the sessions of the Eighth American Scientific Congress and established a preliminary organization.

The services and resources of the United States Arrangements Committee for the Twenty-Fifth Biennial Session of the International Statistical Institute (indefinitely deferred because of the war) were made available for the tasks of completing the organization.[2] Statutes were drawn and approved, an initial "constituent" membership was established, the required minima of governmental adherences and appropriations were secured and the new Institute's affairs were placed in the hands of its own elected officers at a meeting in Charlottesville, Virginia, on August 21–23, 1942.

ORGANIZATION[3]

The new Institute sought escape from the chief organizational handicap of its parent. The International Statistical Institute is limited to maxima of 25 ordinary and 5 honorary members from any single Nation and to totals of 225 and 25, respectively. These members are elected for life, without regard to continuation of the factors which may have counted heavily in their original selection. The heads of official statistical services were frequently elected to membership because of an official eminence which proved temporary. A portion of the limited number of memberships was thus at any time preempted by an older generation of former office-holders without current claims to professional distinc-

[2] The Committee was originally composed of Halbert L. Dunn, Raymond Pearl, Walter F. Willcox and Stuart A. Rice, Chairman. Following Pearl's untimely death his place was filled by E. Dana Durand. A number of ex officio institutional members have subsequently been added to the Committee to assure responsible disposition of its remaining funds at such time as circumstances may permit their expenditure for the resumption of worldwide statistical relations.

[3] See the organization chart reproduced with this article.

tion. The Inter American Statistical Institute, on the other hand, provides that the chief statistical officer of each American Nation (including Canada) shall be *ex officio* a member of the Institute *during term of office only*. He may also be elected to "constituent" membership, but only as a person "distinguished for . . . professional attainments and for . . . contributions to statistical science and development in the Western Hemisphere . . . " These *ex officio* members in most cases serve also as *correspondents* of the Institute on behalf of their respective nations.

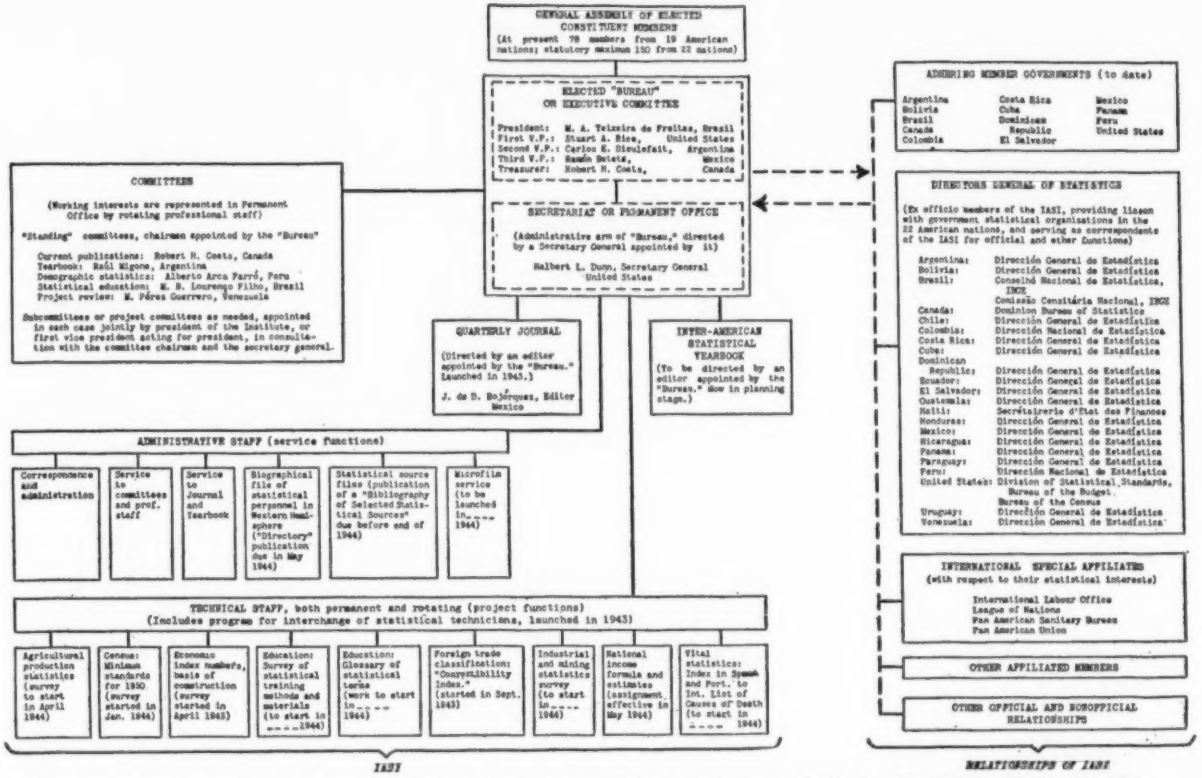
The Institute is unique among international organizations in that control of its affairs is held tightly by its "constituent" or professional members while its principal income is received from governmental sources. "The government of the Institute is vested in the general assembly of constituent members . . ." The dues of governmental members have been fixed at 20 cents per 1,000 of population, as determined for similar purposes by the Pan American Union. Each member government is asked to name an ex officio member to represent it, and the same representation is given to other organizations which may be admitted to "adhering" membership upon their demonstration of statistical interest and the payment of an annual membership fee of $100.

At this writing the following governments in order of adherence have become members of the Institute: Dominican Republic, Bolivia, Mexico, Costa Rica, United States, Brazil, Peru, Panama, Canada, Colombia, Argentina, El Salvador, Cuba and Ecuador. The participation of the Dominion of Canada for the first time in an officially recognized inter-American organization is especially noteworthy. The Brazilian Institute of Geography and Statistics and the General Bureau of Statistics of Uruguay are the present adhering members other than governments, while the Pan American Union, the Pan American Sanitary Bureau, the International Labour Office and the League of Nations have been recognized as special affiliates. The controlling "constituent" membership now numbers 78 persons from 19 American Nations.

The Institute is headed by a President, three Vice Presidents and a Treasurer, each elected by the constituent membership and each accredited to a different member country. Together these officers constitute the "Bureau," or executive committee, which is the governing body "during interims between regular sessions" of the General Assembly. The Permanent Office is located in the Census Building in the City of Washington, under the direction of a Secretary General elected by the Bureau.

Although the Permanent Office maintains a central staff it is a settled policy that, so far as may be practicable, the Institute's activities will

INTER AMERICAN STATISTICAL INSTITUTE (IASI)*
FUNCTIONAL CHART


GENERAL ASSEMBLY OF ELECTED CONSTITUENT MEMBERS
(At present 78 members from 19 American nations; statutory maximum 150 from 22 nations)
ELECTED "BUREAU" OR EXECUTIVE COMMITTEE
President: M. A. Teixeira de Freitas, Brazil
First V.P.: Stuart A. Rice, United States
Second V.P.: Carlos E. Dieulefait, Argentina
Third V.P.: Ramón Beteta, Mexico
Treasurer: Robert H. Coats, Canada
SECRETARIAT OR PERMANENT OFFICE
(Administrative arm of "Bureau," directed by a Secretary General appointed by it)
Halbert L. Dunn, Secretary General
United States
COMMITTEES
(Working interests are represented in Permanent Office by rotating professional staff)
"Standing" committees, chairmen appointed by the "Bureau"
Current publications: Robert H. Coats, Canada
Yearbook: Raúl Migone, Argentina
Demographic statistics: Alberto Arca Parró, Peru
Statistical education: M. B. Lourenço Filho, Brazil
Project review: M. Pérez Guerrero, Venezuela
Subcommittees or project committees as needed, appointed in each case jointly by president of the Institute, or first vice president acting for president, in consultation with the committee chairman and the secretary general.
QUARTERLY JOURNAL
(Directed by an editor appointed by the "Bureau." Launched in 1943.)
J. de D. Bolívar, Editor
Mexico
INTER-AMERICAN STATISTICAL YEARBOOK
(To be directed by an editor appointed by the "Bureau." Now in planning stage.)
ADMINISTRATIVE STAFF (service functions)
Correspondence and administration
Service to committees and prof. staff
Service to Journal and Yearbook
Biographical file of statistical personnel in Western Hemisphere ("Directory" publication due in May 1944)
Statistical source files (publication of a "Bibliography of Selected Statistical Sources" due before end of 1944)
Microfilm service (to be launched in ____ 1944)
TECHNICAL STAFF, both permanent and rotating (project functions)
(Includes progress for interchange of statistical technicians, launched in 1943)
Agricultural production statistics (survey to start in April 1944)
Census: Minimum standards for 1950 (survey started in Jan. 1944)
Economic index numbers, basis of construction (survey started in April 1943)
Education: Survey of statistical training methods and materials (to start in ____ 1944)
Education: Glossary of statistical terms (work to start in ____ 1944)
Foreign trade classification; "Convertibility Index." (started in Sept. 1943)
Industrial and mining statistics survey (to start in ____ 1944)
National income formula and estimates (assignment effective in May 1944)
Vital statistics: Index in Spanish and Port. to Int. List of Causes of Death (to start in ____ 1944)
IASI
ADHERING MEMBER GOVERNMENTS (to date)
Argentina
Bolivia
Brazil
Canada
Colombia
Costa Rica
Cuba
Dominican Republic
El Salvador
Mexico
Panama
Peru
United States
DIRECTORS GENERAL OF STATISTICS
(Ex officio members of the IASI, providing liaison with government statistical organizations in the 22 American nations, and serving as correspondents of the IASI for official and other functions)
Argentina: Dirección General de Estadística
Bolivia: Dirección General de Estadística
Brazil: Conselho Nacional de Estatística, IBGE
Comissão Censitária Nacional, IBGE
Canada: Dominion Bureau of Statistics
Chile: Dirección General de Estadística
Colombia: Dirección Nacional de Estadística
Costa Rica: Dirección General de Estadística
Cuba: Dirección General de Estadística
Dominican Republic: Dirección General de Estadística
Ecuador: Dirección General de Estadística
El Salvador: Dirección General de Estadística
Guatemala: Dirección General de Estadística
Haiti: Secrétairerie d'Etat des Finances
Honduras: Dirección General de Estadística
Mexico: Dirección General de Estadística
Nicaragua: Dirección General de Estadística
Panama: Dirección General de Estadística
Paraguay: Dirección General de Estadística
Peru: Dirección Nacional de Estadística
United States: Division of Statistical Standards, Bureau of the Budget. Bureau of the Census
Uruguay: Dirección General de Estadística
Venezuela: Dirección General de Estadística
INTERNATIONAL SPECIAL AFFILIATES
(with respect to their statistical interests)
International Labour Office
League of Nations
Pan American Sanitary Bureau
Pan American Union
OTHER AFFILIATED MEMBERS
OTHER OFFICIAL AND SEMIOFFICIAL RELATIONSHIPS
RELATIONSHIPS OF IASI

* For further details, see *The Inter American Statistical Institute—Its Origin, Organization, and Objectives*, Washington, D. C., 1943, 48 p.

be decentralized throughout the hemisphere. This decentralization will be evident in the description of current and pending activities which follows hereafter.

COMMITTEES

At the first session of the Bureau five standing committees were created through which to direct projects undertaken: A Committee on Projects, headed by M. Pérez Guerrero of Venezuela, has functions analogous to those of the Problems and Policies Committee of the Social Science Research Council in the United States. It serves both as a planning and a screening instrument, and the results of its work will generally appear in the creation of *ad hoc* project committees for particular approved undertakings. William F. Ogburn of the United States serves as Technical Adviser to this Committee, the remaining members of which are Institute members from Argentina, Chile and Cuba.

Because of the central importance of its publications in the Institute's plans the Committee on Current Publications (headed by Robert H. Coats of Canada) and the Committee on the Inter-American Statistical Yearbook (headed by Raúl C. Migone of Argentina) have in their respective memberships all members of the Bureau. A Committee on Statistical Education, under the chairmanship of M. B. Lourenço Filho of Brazil, has jurisdiction over project proposals and undertakings designed to improve the methods and materials of statistical training, while a Committee on Demographic Statistics, headed by Alberto Arca Parró of Perú, was given similar responsibility for project proposals dealing with population censuses, vital statistics, and other demographic data. Regardless of the work which might subsequently be undertaken in other directions, it was deemed clear and essential that the Institute should move in the directions indicated by its five standing committees from the very start.

The Projects Committee is establishing a subcommittee on Standards for Balance of International Payments Statements. The Demographic Committee is establishing a subcommittee on Index to International List of Causes of Death in Spanish and Portuguese. These merely suggest the extent to which Committee additions and proliferations may be anticipated as the Institute's program progresses.

STAFF

The tremendous distances between national capitals and population centers in the Western Hemisphere give rise to special problems for such an organization as the Institute, affecting both its committees and its staff. A partial solution of these difficulties was initiated by the

Institute's distinguished President, Dr. M. A. Teixeira de Freitas, Secretary General of the Brazilian Institute of Geography and Statistics. Highly placed statistical officers—specialists in selected subject matter fields—are being released by their governments to one year periods of service in the Permanent Office. The governments participating as well as the fields of specialization will presumably be rotated, granted some degree of opportunism, in order to spread the leavening effects which may be expected to flow from the plan. The assignees will not only strengthen the central staff in the Permanent Office but will simultaneously provide staff assistance to the project committees to which their work relates. Other technicians will be added to the group as opportunity permits under a variety of fellowship programs. All of this composite staff will assist in formulating the Institute's varied programs in their particular areas of competence.

The Permanent Office is currently receiving, or will shortly receive under arrangements of this sort already perfected, professional service in residence as follows: From Brazil, a specialist working on comparability of foreign trade classifications; from Peru, an expert working on population censuses, looking toward a hemispheral census in the years 1950–51; from Colombia, a leading agricultural statistician will seek the adaptation to Latin-American countries of procedures for making crop and livestock estimates and for conducting agricultural censuses; from Chile, an expert is expected to work on the statistics of mineral and industrial production. These are in addition to regular staff and project staff appointments. They are also in addition to staff appointments on Institute activities carried on elsewhere than in the Permanent Office.

Thus the Editor of the quarterly journal *Estadística* has been made responsible for his own staff arrangements at the journal's office in Mexico City. The Institute has been served in the field by two part-time representatives, Dr. Forrest Linder whose services have been loaned in connection with other South American work by the United States Bureau of the Census; and Dr. Roberto Guye whose time is shared equally by the Institute and the International Labour Office.

FIELDS OF WORK CONCENTRATION

The creation of the Institute has been widely welcomed by numerous official inter-American conferences and congresses, the felicitous resolutions of which have frequently included requests for Institute attention to a wide variety of statistical issues. The Eighth American Scientific Congress alone, in a series of 15 resolutions, "covered the waterfront"

in a comprehensive enumeration of specific statistical undertakings which were urged as suitable for Institute effort. Since energies would be dissipated if work were attempted simultaneously upon all of these, certain areas of concentration have been agreed to. Some of these have been indicated in the preceding itemization of standing committees. Three principal criteria have affected the selection: first, the relative importance of data; second, the effects upon general statistical improvement to be expected from a given activity; third, the availability of qualified committee and staff personnel.

Hemispheral needs for information and at the same time unfilled gaps in data have seemed to be greatest in respect to population and demography, and basic production in agriculture, extractive and manufacturing industries. Information on trade relations is likewise important. Hence the existing statistics in these areas have been initially chosen for study.

However, a *sine qua non* for any enduring program of statistical activity is a supply of competent professional personnel. Hence another basic area of Institute interest is that for which the Committee on Statistical Education was constituted. The preparation of statistical textbooks in Spanish and Portuguese; the translation where needed of standard texts, manuals and handbooks; and the development of statistical courses in universities and colleges are among the objectives which this committee seeks to advance.

A general leverage for the development of better and more comparable economic statistics is being sought through the *Inter-American Statistical Yearbook* and the project on national income estimates. These require separate explanation.

INTER-AMERICAN STATISTICAL YEARBOOK

Through the pioneering enterprise of Mr. Raúl C. Migone and his collaborators, 1940 and 1942 editions of an *Inter-American Statistical Yearbook* have been published under the sponsorship of the Argentine Commission of High International Studies. Lacking the contacts and facilities which the Institute now provides, the editors of this groundbreaking work were compelled for the most part to utilize data which had previously been collected or assembled and published by other international organizations. In complete agreement as to the desirability of a more direct approach to the task, Mr. Migone generously agreed to throw in his interests with the Institute and to serve as Chairman of the Institute Committee which will continue the Yearbook series. A "dummy" of tables for the revised publication is now in preparation

and work will be carried on hereafter in direct association with the Permanent Office and with the official statistical offices which must supply the basic data. It is hoped that the first volume of the revised yearbook may appear in 1945. But even more important than the appearance of a useful statistical abstract will be the strain towards improvements of standards, toward the widening of activities, and toward increased statistical comparability among the American Nations that will result from preparation of the volume.

NATIONAL INCOME PROJECT

At the request of the Director General of the United Nations Relief and Rehabilitation Administration the Institute has agreed to advise UNRRA and its American member governments concerning their estimates of national income. Governor Lehman's request results from the provision which bases national contributions upon national income estimates. The National Bureau of Economic Research has accepted the Institute's invitation to join in sponsoring and directing the project, which will be placed under the supervision of Dr. Simon Kuznets of the National Bureau staff.

THE QUARTERLY JOURNAL

The first five issues of the Institute's attractive quarterly journal, *Estadística*, have now appeared (on time) from the publication office in Mexico City. Under the energetic and imaginative direction of its distinguished editor, Juan de D. Bojórquez, this journal has adopted numerous editorial departures which are unfamiliar in statistical periodicals. Articles appear in the language of the author, whether Spanish, English, Portuguese or French, with brief multilingual summaries. *Estadística* serves as a medium of communication concerning the affairs of the Institute among its members as well as a vehicle for disseminating statistical articles and notes of general interest. It is hoped that certain current statistical series may be developed for regular appearance in its issues. It is nominally priced at two dollars per annum in the hope that its range of influence may be widely extended.

OTHER PUBLICATIONS

Even before its organization was completed the Institute published through its Temporary Organizing Committee an 842 page compendium entitled *Statistical Activities of the American Nations*. This was intended as an initial guide to the statistical services of the 22 American Nations, and was also nominally priced at two dollars with

a view to wide distribution. It is extensively and constantly in use by Government agencies and others concerned with inter-American affairs. A small descriptive brochure entitled *The Inter American Statistical Institute: Origin—Organization—Objectives* has recently been reissued in a second, revised edition. A *Biographical Directory of Statistical Personnel* in the American nations has also been published and is under current revision.

MICROFILM SERVICE

Arrangements have been completed with the Coordinator of Inter-American Affairs for the monthly airmail distribution by the Permanent Office to the *Dirección General de Estadística* in each American country of microfilmed material of general statistical interest, carefully selected and ingeniously indexed for use and handling. This service is the particular brain-child of the Secretary General, Dr. H. L. Dunn. Reading machines are to be provided by the Coordinator's Office and it is hoped that the service will soon develop into a two-directional exchange. Data and source documents which would not otherwise reach them promptly, if at all, will come quickly and conveniently to hand in every key statistical office of the hemisphere. This will include much unpublished material pertaining to the organization and procedures of statistical activities in all of the American Nations. Only those who have fruitlessly sought to obtain them will appreciate how difficult it is to secure copies of basic schedules and instructions employed in the statistical inquiries of other countries. The use by business and government of *teletype* communication will find here a realistic analogue.

A GENERAL APPRAISAL

The creation of the Inter American Statistical Institute has evidently served a genuine need, not elsewhere satisfied. The evidence of this is found in its lusty growth and the already heavy demands upon it from many sources for information, assistance, and advice. No one has been more surprised by this than the midwives who attended its birth. Instead of being called upon to conserve a feeble flicker of vitality as they might have expected, these original functionaries are now pulled along by a youthful prodigy in full stride. Whether growth in stature and weight will continue after the war will depend, in my judgment, upon the Institute's preservation of two basic and original characteristics: First, it is an *active* instrument for statistical advancement in the Western Hemisphere; second, it is under the domination of no single American Nation, but belongs equally to all. At age four there seems every promise that these twin conditions of healthy survival will be maintained.

WAR TIME FACTS AND PEACE TIME NEEDS

By Vergil D. Reed
Associate Director of Research, J. Walter Thompson Company
Formerly Chief, General Statistics Staff, War Production Board

It is the duty of every statistician, market research man, business executive and economist to see that dead files do not become the graves for the living and useful facts collected by the war agencies. It is none the less their duty to make certain that a rational minimum statistical program is assured for peace time, that the emotional upheaval when peace comes does not blind us to the necessity of facts for the readjustment period and the more distant future. The best the war agencies have done must be saved. The unbroken continuity for what is worth continuing must be assured. War time series must be adapted to peace time needs and incorporated into a planned statistical program to replace the hodgepodge of unrelated current data that existed before the war.

After World War I and after the dismantling of the National Recovery Administration (1936), a great hoard of industrial and distribution statistics was filed away to gather dust and mold. This was a tragic and unforgivable waste which we cannot afford to repeat.

In 1917, United States *industry expanded* to include war production *instead of converting* to produce war goods. In the present "total" war, extensive and rapid *conversion, as well as vast expansion, was necessary.* Our normal industrial economy has, therefore, become distinctly abnormal for the duration of the present war. The problems of reconversion to a peace economy will be vastly greater this time. Those problems will require sound judgments based upon detailed facts. Ours is no longer a simple economy wherein responsible business or government executives can carry all the necessary knowledge under their hats or depend upon ingenuity and experience alone to make good decisions.

Modern war brings astounding changes in the economics of nations not even directly engaged in hostilities. For those actually engaged, the dislocations imposed upon their production, distribution, and consumption patterns present industry and government alike with a series of problems so complex that only a careful evaluation of cold, hard facts and their application with vision as well as knowledge can give a basis for prosecuting the war and guiding our post-war readjustments.

We have excellent basic statistical information in considerable detail for our pre-war economy. All of this was available to business and industrial interests. Fortunately our 1940 Census gave us a complete

inventory of our minerals production, agriculture, population and labor, housing, manufactures, distribution and services just prior to our entry into the war. These data were extremely helpful in setting up our Selective Service System as well as in converting our industry and quickly translating our resources into ships, planes, tanks, guns, armies and supplies to make their operation effective. Our production had to be on a scale startling even to North Americans, the apostles of mass production.

To attain the vast production needed there had to be direction and coordination of our industrial resources and efforts. That function fell, and still falls, largely upon the War Production Board. Data already available were invaluable as a basis for decisions on policies and plans to be adopted upon our entry in the war. However, it has been necessary to request from industry and keep current a vast amount of timely facts in greater detail for the purposes of direction of effort and measurement of results.

Conversion of plants, plant utilization, scheduling of production, administration of restrictive orders, allocation of materials and manpower, stockpiling, redistribution of equipment and materials, salvage, contracts, construction and requirements—all required a steady flow of current facts. Statistics, and the questionnaires through which they are secured, are an inevitable burden in any intelligent centralized direction and control by government or by business itself. The only alternative is the tragic one of basing judgments, policies, and plans on a combination of intuition, experience and "hunches."

The collection of the facts necessary for the prosecution of the war has resulted in a real hardship and some irritation to industrial concerns during a period of manpower shortage, particularly as to technical and clerical staff. The exasperation of respondents was easy to understand. The need for the data was extremely pressing. The number of necessary questionnaires increased greatly. Many of the additional questionnaires came from regulatory agencies. Practically none of the compilations of resulting data could be made available to business since they were classified as "restricted," "confidential," or "secret," for military security reasons. Industry was receiving no dividends of information on its heavy investment in facts furnished the Government. Ironically, the business man was suddenly deprived of current data at the time when he felt he needed them most and when he was being asked to contribute far more to the total fund of industrial knowledge.

The restrictions were accepted by industry at first as a military neces-

sity in spite of the handicaps they involved for management. However, as the war progressed and our output grew past the stage of critical shortages, the demands by business organizations, trade papers, research groups, and individual companies became more and more insistent to make greatly needed current facts available to business again.

Believing that our prosecution of the war had reached the point where some of the rigid restrictions on industrial data could be removed, and that making them available to business again would not only be helpful in attaining our maximum war output but in planning for post-war readjustments, the following recommendations were made by the Chief of the General Statistics Staff to the Chairman of the War Production Board in September 1943:

1. That War Production Board policies be liberalized to provide industry regularly with current data from the vast amount of statistical material collected by WPB. Management's needs for basic industrial facts are even greater in war than in peace, yet access to such facts is largely denied at present.

2. That such statistical series or reports be distributed to trade papers, trade associations, the Department of Commerce, the U. S. Chamber of Commerce and the Committee on Economic Development. These organizations should be encouraged to give such facts wide circulation. This procedure would assure wide dissemination with the minimum of WPB man-hours expended in publication.

3. That an agreement be made immediately with the Department of Commerce with the approval of the Bureau of the Budget under which any existing statistical series before being discontinued by WPB would be referred to the Department of Commerce for its consideration as to the desirability of continuance by the Department without breaking the series. This agreement should be made now, regardless of when the war or any part of it ends. Other organizations such as the Bureau of Mines, the Tariff Commission and the Forest Service have vested interests in certain series which should be given similar consideration.

4. That steps be taken in cooperation with the Bureau of Mines to make public through its Minerals Year Book the minerals production series formerly carried in it, excepting only those few minerals the major portion of which are imported, or the disclosure of which would actually give aid and comfort to the enemy. Disclosure of the data on most of these minerals should be most discomforting to the enemy.

5. That the advice of the Industry Advisory Committees of WPB be sought as to the statistical series which should be continued after the war.

6. That those series now being collected and tabulated by the Bureau

of the Census for and at the expense of the WPB be published jointly by the Department of Commerce and WPB. This would assure continuity without confusion by simply withdrawing the name of WPB on any series when WPB desires to withdraw. The Department could prepare and make the releases. WPB would retain the right to review and approve releases, so long as its interest in the series continues.

7. That the first release of any series be submitted to the Security Officer for clearance and approval as to security.

8. That all releases made exclusively by Divisions or other units of WPB be made through regular Division of Information channels and that the head of the issuing unit be responsible for the statistical accuracy of the release but not for the security status of the data.

These recommendations were accepted by the Chairman of the War Production Board without change, and accepted by the Division of Statistical Standards, Bureau of the Budget, in principle. Procedures to put the plan into effect were readily agreed to by the Bureau of the Budget and other cooperating Government agencies involved. These procedures will be covered later in this paper.

Very soon after adoption of these recommendations it was found desirable, and mutually agreed, that even releases prepared entirely by the WPB should be processed and distributed for the Board by the Bureau of the Census rather than by the Division of Information of WPB since that organization's main interests lay with newspapers rather than with trade papers and business organizations.

Two types of data are being published. Current data collected on a monthly or quarterly basis constitute the major contribution. These are released as continuing series with the primary release showing base data for as many annual periods as are available and which conform to certain statistical standards. In many cases these series may even be "tied" to Census of Manufactures data for 1939, the last year for which such a census was taken. These initial releases, besides establishing a base for the series, carry the periodic figures up to date. Subsequent releases in each series will be monthly or quarterly depending upon the time intervals covered by the reports required from the industrial plants covered.

The second type of data to be published comes from, or may include all significant facts collected in certain "one time" statistical reports or surveys made by the War Production Board or by other agencies for the War Production Board. Examples of this type of release are (1) "A Survey of the Printing and Publishing Industry," made for WPB by the Bureau of the Census, (2) "Production and Distribution of Commodities under the Controlled Materials Plan," prepared within WPB,

and (3) "Lumber in the War Program 1940–43," done by the Census Bureau for WPB.

Certain studies of special problems involving the consolidation and analysis of data from several sources may also be published. The variety of subject matter available for publication is great. The amount of data available and the time period covered, however, vary for the different commodities, functions, and categories. For many of those items which were critical at the beginning of the war, or previous to our entry, excellent detailed information is available over two or more years. In other cases the collection of current data was not undertaken until critical situations arose later or the establishment of controls became necessary. In some cases studies or surveys of an entire industry were made. Sample surveys of consumer requirements have also been carried out. Production, shipments, consumption, stocks and requirements had to be measured for many materials, components, and end products ranging from abaca to zinc.

A few examples from series already released best indicate the types of data available and the value they have to business and other users of statistics. These include:

1. Aluminum Castings: Monthly Shipments by Type
2. Aluminum Ingot: Monthly New Supply
3. Aluminum Fabricated Products: Monthly Shipments
4. Magnesium Ingot: Monthly Production
5. Magnesium Fabricated Products: Monthly Shipments
6. Automotive Replacement Type Storage Batteries: Quarterly Shipments
7. Motor Trucks and Truck Tractors: Annual Production 1940–43, Monthly Production 1943
8. Electric Lamps and Bulbs: Quarterly Production and Shipments
9. Dry Cell Batteries: Quarterly Production 1940 and 1943, Quarterly Shipments 1943
10. Cutlery: Quarterly Production and Shipments
11. Photographic Film: Quarterly Production and Shipments
12. Domestic Ice Refrigerators: Quarterly Production and Shipments
13. Chemicals (by many specific items): Production, Consumption, and Stocks 1941–43 and Monthly Production, Consumption and Stocks
14. Metal Cans: Monthly Shipments, by Product to be Packed
15. Softwood Plywood: Monthly Production, Consumption and Stocks
16. Home Canning Supplies: Jars, Closures, and Sealing Rings Produced, Oct. 1, 1940–Sept. 30, 1943
17. Pulp Mills and Paper and Paperboard Mills (Census, 1942 and 1943)
18. Softwood Plywood: Monthly Production, Consumption and Stocks
19. Paper and Paperboard: Monthly Production, by Type

20. Asbestos Textiles: Allocations by End Use—Last 3 Quarters 1943
21. Metal Cutting Tools: Monthly Shipments and New and Unfilled Orders
22. Machine Tools: Monthly Shipments and New and Unfilled Orders
23. Lumber in the War Program: Production, Deliveries, Military and Civilian Consumption, 1939–43
24. Industrial Diamonds: Annual Imports 1929–40, Quarterly Sales 1941–43
25. Waste Paper: Receipts and Inventory, 1941 to October 1943
26. Safety Equipment: Distribution 1943 and Requirements for 1944
27. Cotton and Rayon Mill Production and Unfilled Orders, by Types, Quarterly
28. Portable Electric and Pneumatic Tools: Shipments, New and Unfilled Orders, 1942–43
29. Containerboard: Monthly Inventory at Converting Plants by Type of Board and Zone
30. Shipping Containers, Corrugated and Solid Fiber: Monthly Shipments by Rating Pattern, July 1943–January 1944
31. Woolen and Worsted Woven Fabrics, by Types, Production, by Quarters
32. Men's, Youths' and Boys' Dress and Work Clothing: Garments Cut and New Orders Accepted, by Types of Garments, by Quarters
33. Cattle Hides, Producers and Dealers Report of Production, Purchases, Sales and Stocks, by Months

Although such series do not give a complete picture of all industry, as is true of a census, they do for the first time since we entered the war, afford a factual view of many of its segments. The list does not include all series being published. Others will also be issued as the data can be prepared.

To assure reasonable standards, certain criteria are used to determine whether or not publication is advisable. The first of these is probable usefulness of the data to business men, economists, and research organizations. Significance and the possibility of drawing sound conclusions from a series outweigh mere statistical perfection, provided that the limitations and short-comings of the data are reasonably well known and can be called to the attention of users so that they will not be misled. How seriously do faults distort the final results? Of what magnitude are the probable errors and exclusions? In other words, are the data accurate enough for most purposes for which they will be used?

It must be kept in mind that most of our present statistics were collected under emergency conditions and the resulting pressures for speed; decisions had to be made on the basis of facts which could be made available quickly on critical questions. The result is that there

are many data in WPB which met and are meeting our immediate operating needs but which are not of sufficient accuracy or completeness to justify publication for other uses. Some of these may be improved later to the point where they can be published. Others will never be published. In certain instances series will be released which are admittedly incomplete because they are the only data or the best available anywhere on a critical subject.

Definitions of the items and subject matter covered in each release must be specific as to what is included, what is excluded and what is most pertinent. The coverage of the series or report as to number of plants or companies, and percentage of the total industry covered in terms of production, shipments, scheduled output, or other such categories must be shown. Comparability of coverage through the time period involved and the extent and time of variations will be stated.

The sources of the data, the methods of collection and compilation used, and relationship to other series will be checked. In the case of joint releases with other government agencies all data must be checked and approved by both agencies involved. Credit must be given for any data included from other sources. No forecasts based upon probable or possible policy changes of WPB can be issued.

Geographic distribution of plants covered, if significant to the practical use of the series, should be shown when possible. Disclosures of the operations of individual plants or companies are to be avoided except with the written permission of the disclosed respondent. Standard industrial and commodity classifications are to be used whenever possible.

The Chief, General Statistics Staff, was given the responsibility and authority to establish procedures and issue instructions for implementing the new WPB policy of releasing industrial data to the public. These procedures are outlined below.

A complete inventory of all questionnaires or data requests and related forms in WPB was made by the General Statistics Staff. The information was classified, analyzed, and compiled into a book *Analysis of Use of WPB Forms: Coverage, Methods, and Contents.* Approximately 450 copies of this book were published mainly for official use. They were practically all "spoken for" before they came off the press. A revised version of this book has been published and is available from the Board upon request.

Of the total forms studied 508 were classified as data requests or questionnaires. The information reported by respondents on these 508 forms is grouped below into 10 specific categories with the number of forms upon which each appeared:

1. Capacity	70
2. Production	
(a) Actual	204
(b) Scheduled	111
3. Shipments	271
4. Consumption	181
5. Receipts of Accepted Deliveries	178
6. Inventory	339
7. Orders	
(a) Unfilled	147
(b) New	119
(c) Cancelled	52
8. Requirements	102
9. End Use Pattern	128
10. Others	151

Other information compiled on each form included: title of form, related order, frequency of return, due date of report, class of respondents, number of respondents, estimated coverage, type of form, whether or not tabulated, form in which summary data are presented, and persons to whom data are regularly presented. This book is the key to all data available in WPB. Perhaps, the suggestion that other war agencies furnish such a key to their wealth of data is in order.

All series and reports falling under the plan are to be known as the "Facts for Industry" Series. They are to be issued in a standard format (See Chart) which is readily recognizable and which identifies the WPB Division and the collecting agency, if any, the series, and the individual release within each series. The family resemblance and identifying numbers result in ready recognition, easy filing, quick reference, and definite allocation of responsibility.

All proposals for the publication of statistical data are initiated by or submitted to the Chief, General Statistics Staff, who is responsible "for obtaining agreement on the technical validity and adequacy of the data, for obtaining any necessary agreements and clearances within the War Production Board and with other government agencies, and for authorizing the discontinuance of any series established."

The initial release in any series is submitted to the Bureau of the Budget which is responsible for obtaining all military security clearances. Subsequent releases within a series are finally approved for publication by the General Statistics Staff.

Agreements may be made with other government agencies through Budget Bureau assistance whereby statistics collected by them for

CHART

WAR PRODUCTION BOARD
Forest Products Bureau

U. S. DEPARTMENT OF COMMERCE
Bureau of the Census

For Release on
January 12, 1944

"Facts for Industry"
Series 16-1-2

SOFTWOOD PLYWOOD

Production, Shipments and Stocks of Softwood Plywood, and Consumption and Stocks of Materials, October–November 1943

Item	November 1943	October 1943	November 1942

WPB or regularly compiled by them but preempted by WPB may be issued jointly by WPB and the collecting agency. Preparation for publication is to be done by the collecting agency but such joint releases are cleared by the General Statistics Staff with the sponsoring Division in WPB. Joint releases are issued and distributed by the collecting agency. WPB retains the right to review and approve all such joint releases, so long as its interests in any series continue.

The collecting agency, excepting WPB which publishes and distributes its releases through the Census Bureau, is responsible for the actual publication and distribution of all approved releases and keeps a record of media to which releases are sent.

Correspondence requesting technical explanations or interpretations is referred to the Division or other unit within WPB responsible for the series to which the correspondence refers, or to the collecting agency in the case of joint releases.

Proposals for discontinuance of a series must be approved by the General Statistics Staff. The proposal must be submitted sufficiently in advance to allow transfer of the series without interruption, to some other Federal agency should the Bureau of the Budget and the agency involved decide that continuance is desirable after WPB has no further need for the data.

The "Facts for Industry" series affords an excellent example of what can be accomplished through the cooperation of various government agencies. Little additional burden is put on any one of them, yet a very appreciable volume of related and coordinated data can be made available and each agency is assured proper recognition for its contributions. The nature of the releases makes this cooperation apparent to the public. Represented in this cooperative effort are such diverse government agencies as: The War Production Board, The Department of Commerce (Bureau of the Census and Bureau of Foreign and Domestic Commerce), The Tariff Commission, The Bureau of Mines, The Forest Service, and the Bureau of the Budget (Division of Statistical Standards). In addition, several private organizations such as the United States Chamber of Commerce, the Committee on Economic Development, trade associations and trade paper editors have pledged their cooperation in the wide dissemination of the data.

Other government agencies are being encouraged to take similar steps to secure the release and publication of data which they have collected during the war, even though the War Production Board may have no official interest in their particular fields.

Both private and government agencies having responsibilities and interests in post-war planning or readjustment can be much more effective and realistic in their work through using the facts being made available. If industry and business secure immediate benefits from the statistics already collected; if they have the opportunity to judge, and weigh, and evaluate their usefulness, much more intelligence will be used in choosing those which should be continued after the war. Industry will cooperate actively to save and improve those series which it has already found valuable, but it cannot be expected to advocate continuing series which it does not know are in existence and which it has had no opportunity to judge as to usefulness. It must always be kept in mind that those in industry are respondents as well as users. No amount of compulsion in reporting will attain the quality or completeness of returns which cooperation based on an appreciation of usefulness brings with it.

Publication of the "Facts for Industry" series removes WPB from the untenable position of denying to business and industry useful facts which it already has in its possession, and which admittedly in most cases are the only facts available showing what has happened to industries and commodities since we entered the war.

Needless duplication of effort and duplicate reporting by respondents can be avoided through publishing these data. Many trade associations

have found it necessary to duplicate the collection of data from their industry members. They could not get them from WPB, although in many cases the desired facts were already collected and tabulated, but could not be released. Many of the criticisms and contradictory statements in the trade and daily press, which tend to confuse the public, have resulted from the lack of availability of official facts. These facts, if known, at least in many cases, would justify the policies and decisions of WPB at the same time they would enlighten management on its present and future planning. This means better public relations and better industrial relations as well as additional services rendered to business. An enlightened public is apt to be a more cooperative public.

The War Production Board has taken, in its "Facts for Industry" series, the first step to avoid a recurrence of the regrettable demise and burial of useful data which followed the last war, and has assured business of useful current data for present operations. There are many more facts in many more war agencies. The next steps seem clear. The responsibility for their being taken falls squarely on the shoulders of those who need the facts—you and I and he and she. . . .

CENTRALIZED INTERNAL CONTROL OF DATA COLLECTION BY FEDERAL AGENCIES

By Edward T. Crowder
Bureau of the Budget

There is now considerable familiarity both within and without the statistical profession with the control exercised by the Bureau of the Budget over the collection of data by agencies of the Federal government. There is no doubt less general familiarity with the internal procedures within various Federal agencies which have been designed to provide internal statistical controls analogous to that provided for the Federal government as a whole by the Bureau of the Budget. In a recent report[1] the Bureau of the Budget pointed to the existence of some fifteen internal control offices, through which flow the great bulk of the report forms submitted to the Bureau for final approval.

These internal control mechanisms are significant not merely with relation to the swollen volume of wartime reporting to the Federal government, but also with respect to the longer range problem of introducing a maximum of efficiency and order into the Federal statistical program. It is the purpose of this paper to discuss briefly their development in recent years; the conceptual basis for such control; and some of the actual problems involved in the establishment and operation of control offices.

The development of internal statistical control is best understood against the background of the government-wide program of statistical coordination and control which has been developed by the Division of Statistical Standards of the Bureau of the Budget (and from 1933 to 1940 by its forerunner, the Central Statistical Board). This program has sought to improve, and to introduce a maximum of order and efficiency among, the highly decentralized statistical services carried on by the various Federal agencies. The Bureau's authority and responsibility as a statistical control agency has recently been given specific legislative endorsement by the Federal Reports Act of 1942,[2] which is aimed at the elimination of duplication in Federal data collection, the reduction of the reporting burden on the business community, and increased efficiency in the collection and use of Federal statistics. Much of the activity of the Division of Statistical Standards has consisted of the review of specific plans for the collection of data from the public,

[1] "Report of Progress under the Federal Reports Act," in *Congressional Record*, March 16, 1944, Vol. 90 (Temp. file), p. 2691.

[2] "An Act to coordinate Federal reporting services . . . ," Public Law 831, 77th Congress, 2d Session, Approved December 24, 1942.

which plans must, with certain exceptions, be approved by the Bureau before adoption. Approved forms or questionnaires are assigned "Budget Bureau approval numbers" to aid the respondent in distinguishing authorized from unauthorized inquiries.

A fully developed internal control office within a Federal agency should perform within that agency a statistical control function analogous to that of the Bureau of the Budget. It should approve each questionnaire, reporting requirement, or other means of collecting data from the public before the final approval by the Bureau of the Budget is requested. It should undertake a substantive review of the proposals sent to it and be responsible for internal clearance of projects of interest to more than one part of the organization.

Internal control of this sort has had a tardy development. On the basis of a survey of Federal report forms used in 1938, the Central Statistical Board observed that:

> Only some half a dozen agencies have either developed, or are now in the process of developing, orderly methods of reviewing their own questionnaires and report forms, and of keeping records concerning the adoption and use of forms to collect information from the public. The general lack of centralized authority for and even of basic records on report forms in Federal agencies is undoubtedly one reason for some of the duplications in Federal reporting requirements. Moreover, this lack of centralized authority is a contributing factor in the accumulation of unnecessary burdens upon respondents.[3]

The Board recommended legislation requiring the keeping of uniform records on the collection of data from the public and the centralization within each agency of responsibility for authorizing questionnaires and report forms and for maintaining the required records.

A powerful impetus in this direction has come from the present war. Priorities and allocations, price control, economic warfare, selective service, military and naval procurement, and other phases of governmental defense and war activity involved the collection of great quantities of data which the government had not previously had occasion to require. Much of this data collection was necessarily carried on by newly assembled personnel, sometimes in newly established organizations. A critical problem of coordination and control arose which was emphasized by the mounting resentment by the public of the avalanche of government questionnaires.

The problem was not unrecognized by the agencies themselves, and

[3] *Report of the Central Statistical Board on Returns Made by the Public to the Federal Government*, House Doc. No. 27, 76th Congress, 1st Sess., p. 24. For a brief reference to the internal clearance arrangements which had been worked out within the Department of Agriculture, see the *Fourth Annual Report of the Central Statistical Board, July 1, 1937, to June 30, 1938*, p. 6.

by the summer of 1942 internal control mechanisms had been established within the four agencies responsible for the largest volume of data-collection projects (the War Production Board, the Office of Price Administration, and the War and Navy Departments). The appreciation of the problem among government agencies was increased, moreover, by the adoption by the Bureau of the Budget of the "approval number" system (August, 1942) and the passage a few months later of the Federal Reports Act. The Bureau of the Budget subsequently required in its clearance regulations that no project be submitted to the Bureau for approval until it had been discussed with all interested units within the sponsoring agency and all unnecessary duplication eliminated.

The response to the "questionnaire problem" by the Federal agencies has varied according to the nature, size, and newness of their data-collection programs, the extent of their previous development of internal coordination procedures, and their realization of the need for internal coordination. In March, 1943, the Bureau of the Budget announced in a press release that ten agencies had set up internal control units, while several others had informal arrangements for internal clearance. In its latest announcement on this matter (in the "Report of Progress" cited above) the Bureau pointed to fifteen such control units, through which flow 90 per cent of the forms presented to the Bureau for approval.[4]

As a measure of the current development of internal control within Federal agencies the above figures must be interpreted with caution. Though most agencies have not been recognized as having control offices, the smaller the volume of data collection by the agency and the smaller the likelihood of duplication or conflict among programs, the less pressing is the need for special questionnaire control facilities. There are perhaps agencies where such facilities are not necessary. On the other hand, the degree of actual control exercised by the recognized control offices varies widely, and many projects receive little if any real substantive review. Within a few agencies internal control has had a considerable development, but we are still very far from the effective internal control of reporting programs among the agencies as a whole.

Existing control offices vary in their location within their respective agencies. In the Department of Commerce a special Assistant to the Secretary has a general responsibility for statistical coordination and

[4] The Bureau has recognized the existence of a control office only when there has come to its attention a special procedure which is capable, in the Bureau's opinion, of yielding an appreciable amount of control and coordination. When control offices exist at different levels in an organisation, only the "top" office has been counted.

review. In the Department of Agriculture control authority has been given to the head of the Bureau of Agricultural Economics, and delegated by him to a review officer, who draws on the technical staff of the Bureau for assistance. The "Statistical Standards Branch" of the Office of Price Administration is located in the Administrative Management Department. The "Office of Survey Standards" of the War Production Board is in the Bureau of Planning and Statistics. There appears to be a tendency for the statistical control function to be associated with administrative controls as well as with statistics and research.

Control units vary also in structure, size, procedure, and philosophy. The staff engaged in actual review may consist of several persons or of only one. Review may be intensive or may be concerned only with more general issues. Control offices vary in the degree of responsibility which they assume for negotiations with the Bureau of the Budget in order to obtain final approval of a project.

The Bureau of the Budget, while encouraging the development of internal control offices, has not recommended uniformity in their organization or procedures. It has taken the position that arrangements appropriate to one agency may not necessarily be appropriate to another. It has favored the issuance within an agency of an order designating a clearance office with authority to approve data-collection proposals, and the employment of high grade professional staff members to perform the review work. When problems have arisen within particular agencies the Bureau has from time to time made specific recommendations.

The decision to provide for the review of data-collection activities by a special control office represents a recognition of the peculiar importance of data collection and of the fact that, like position classification or budget planning, it should be subject to special treatment. Just why this is so has not been obvious to those who have been inclined to think that data collection should be controlled only through the normal channels of supervision within the agency. The case for a special control procedure may be seen from an examination of the responsibilities appropriate to statistical control units.

The most obvious field for the activity of a central control office is that of coordination aimed at avoiding duplication of data-collection activity within the agency, at insuring that whatever data are collected have a maximum usefulness to the whole organization, and at insuring consistency among related programs sponsored by the agency. Division A should not collect for its own convenience data which Division B has already collected in a somewhat different, but nevertheless adequate, form. A survey should be so designed as to be of maximum

value to all interested branches. Related programs should be as consistent as possible with respect to reporting units and reporting periods. Coordination of this sort does not necessarily occur within a large organization if reliance is placed on ordinary channels of control or on the spontaneous cooperation of program directors. But the greater the extent to which the program of a single agency involves more than one type of contact with a given respondent group or involves the collection of related statistics through different channels, the greater will be the need for internal coordination. It is clearly more appropriate that it be brought about through an internal control mechanism than that it be imposed by an outside agency.

A second important task for an internal control office is to insure that no more information is sought from respondents than is reasonably necessary. This function derives its importance from the apparent tendency to seek to collect by means of questionnaires or report forms information which either is already available or is not sufficiently necessary to justify the expense and trouble, both to the government and to the respondent, which would be required to obtain it. This tendency is apparent not only in the planning of unnecessary reports but also in the over-elaboration of necessary inquiries, in accordance with what might almost be called a natural "law of the expansion of questionnaires."

The information available to the government for the asking is not unlimited in quantity since it may become available only through the use of scarce resources (particularly personnel) in the offices of the respondents. The answering of an important inquiry may easily be delayed while the respondent answers a less important one which he has received earlier. (Indeed an unduly elaborate questionnaire may defeat itself if the less important questions interfere with a prompt reply to the more important ones.) Central control offices must determine precisely what use will be made of specific information and must reach judgments as to how far it is worthwhile to pursue particular investigations. Any weeding out of the less necessary data requests which can be brought about through internal review should be so brought about and not left to an outside control agency.

Finally, an internal control office may perform a valuable service by enforcing specific standards or policies which may have been adopted relative to data collection and by insuring the statistical and administrative adequacy of reporting projects. There is much that can and should be accomplished by internal review rather than by intervention from the outside. For example, a central control office can insure that all forms fit a standard typewriter; that reporting instructions and

column headings are clear; and that sampling procedures are sound. In reviewing the adequacy of a reporting proposal the control office would not, of course, presume to know more than the sponsors about the specific problem giving rise to the proposal. However, a skilled review staff, with a background derived from contact with a variety of reporting projects, should be able to offer a specialized knowledge of data-collection techniques and problems.

Certain problems seem to be inherent in any attempt to institute internal questionnaire control within individual Federal agencies. One of these arises from the attempt sometimes made to draw a clear line between matters with which a questionnaire control unit is properly concerned and "policy" matters, with which such a unit should not, it is argued, concern itself. This constitutes a problem because data collection may (quite properly) be very closely related to policy. In many cases, in fact, data collection is part of an administrative procedure (as, for example, in application procedures). The need to ask a given question in a given way, of a particular group of respondents, with a particular frequency, may appear to be purely a matter of policy and properly exempt from review by a questionnaire control unit. For example, the decision to reappraise a regulatory program at frequent intervals may seem to dictate a given frequency of reporting. Or detailed reporting by all persons covered by the regulations may seem necessary to insure compliance.

The most feasible approach to this problem is to cease trying to distinguish between data-collection problems and policy problems. A questionnaire control office is properly concerned with the feasibility of a data-collection program and its appropriateness to the objective in view. If the objective will be more effectively attained by revision of the data-collection program, no conflict with "policy" need arise. But if a given policy is so tied up, not to say identical, with a given reporting program that any tampering with the reporting program involves meddling with policy—then it would appear that a review by the questionnaire control unit is more, rather than less, necessary. A policy which stands or falls with a vulnerable reporting program is a vulnerable policy. In such a case review by the questionnaire control office should be carried on with discretion and with due consideration of all factors, but it should not be waived.

A second problem arises from the tendency for the control function to become confused with service functions. This is natural because the work of a control office extends into certain areas which may be regarded as services to the sponsors of plans—for example, form design

and editing, clearance with other interested units, and liaison activity with the government-wide questionnaire control agency.

Surely no control unit should lose sight of the fact that its function is to serve the agency, but the control function must be frankly recognized both by the control unit and by the organization as a whole. Disguising the control function as service may result in unnecessary resentment and resistance when real control must be exercised. Moreover, the effectiveness of the clearance office may improperly be judged by its popularity. Questionnaire control is not simply a service to the controlled units and, even when carried on with a maximum of skill and tact, is inherently unpopular.

A very difficult problem of statistical control arises if an agency establishes field offices which are expected to collect information from time to time on their own initiative. Clearance with the central office is difficult at a distance, and in emergency situations may be inappropriate.

When central clearance is clearly impossible without jeopardizing an operating program, waiver of review or delegation of authority to someone at the scene of the operation is advisable. Thus the central control office of the Office of Price Administration has, with the concurrence of the Bureau of the Budget, dispensed with a preliminary review of projects originating in the Territories and performs only a post audit. There are perhaps other areas in which waiver or delegation of authority is preferable to central clearance. But the danger of unnecessary and uncoordinated collection of data is surely no less present in field offices than in central offices, and the decision that clearance is not feasible should not be reached too quickly and without exploring other alternatives. One such alternative is central *advance* planning, wherever feasible, of the forms and reporting requirements to be used throughout the field. Another alternative is the working out of emergency clearance machinery whereby the general outlines of a particularly urgent proposal are communicated by wire to the central office, which undertakes to act with unusual promptness if the emergency is a real one.

Another problem inherent in internal questionnaire control is concerned with the time at which the review of a given project should begin.[5] If review occurs only at the final stage of planning, when schedules have been designed and administrative arrangements are under way to carry out the project, the function cannot be properly exercised. Any

[5] The problem of timing (as well as certain other aspects of centralized control) has been discussed with special reference to the review activity of the Bureau of the Budget by Luther Stringham in "Government Questionnaires and the Federal Reports Act of 1942," *Public Administration Review*, Vol. III, No. 2 (Spring, 1943), pp. 150 ff.

basic revision made so late in the planning of the program may have serious consequences—so serious in fact that it may be better to approve a defective plan than to attempt to improve it.

The solution to this clearly lies in maintenance of sufficiently close relations between the review and the planning staffs to insure that any major issues are raised early and resolved without jeopardizing a program through last-minute delays. In maintaining this intimate contact, the review staff must be careful not to participate in the planning in such a manner that it loses its objectivity. Any tendency for operating staffs to "borrow" reviewers temporarily to assist in the preparation of plans must be regarded as potentially dangerous to the adequate performance of the control function.

Some insurance against the discovery of unresolved major issues at the final stage of planning lies in the advance announcement of standards to be applied. Certain control offices have prepared for use within their agencies statements of such standards.[6] Standards expressed in general terms may also be found in internal directives dealing with clearance procedures.

Such statements have a distinct educational value. To the extent that they deal in a definite manner with specific issues they may settle questions in advance of actual review. But the usefulness of this device as a preventive should not be exaggerated. Clear and specific statements of policy are fairly easy to formulate with reference to such minor (although necessary) rules as those concerned with format and size. The farther we move into the more difficult problems of insuring clarity and statistical adequacy and avoiding unnecessary questions, any statement of standards tends to become more and more generalized. These generalities, while highly useful, cannot take the place of review of specific projects.

Still another problem concerns the desirability of establishing within an organization a hierarchy of review offices such that a given project is subject to review at one or more levels prior to formal submittal to the control office for the agency as a whole. To the extent that such pyramiding of review represents an awareness of the need for statistical control and to the extent that it is productive of a higher quality of planning, it deserves nothing but commendation. Multiple review within an agency does, however, create a problem of timing. If different reviews must be accomplished successively the loss of time may be so

[6] A thirteen-page pamphlet entitled *Criteria for the Review of Public Reporting Forms and Surveys* and a twenty-page *Questionnaire Manual* have been issued by the OPA and the WPB control offices, respectively. A shorter statement has been issued for use within one division of the Office of Education.

great as to outweigh the benefits of the more thorough review. The solution is to be sought in concurrent review so that by the time a project is ready for approval by the agency control office all issues will at least have been raised, if not settled.

The fact that projects reviewed by an internal questionnaire control office must usually receive the further approval of an outside control office raises additional problems. One of these concerns the degree of responsibility which the internal office assumes for the standards which it enforces. In the face of the control exercised by the Bureau of the Budget it is easy within a given Federal agency to enforce a control program by emphasizing the standards imposed from without. The convenience of such a device, particularly when the philosophy of internal control is not generally accepted within the agency, is undeniable. However, it remains true that the cause of statistical coordination and control is greatly advanced whenever an agency head establishes on his own authority and independently of any outside control a set of standards and a control procedure concerned with the data-collection function.

Another problem arising from the coexistence of internal and external controls is concerned with timing and the avoidance of duplication in the review process. This is analogous to the problem of multiple review within the agency. If external and internal review were identical in scope and purpose, review and approval by a competent internal unit might be a sufficient basis for perfunctory approval by the external office. But a reporting program which from the point of view of a single agency is unobjectionable may be regarded as too burdensome in the light of other reports required of the same respondents by other agencies or may involve a very serious problem of interagency coordination. For these reasons two reviews are in many cases inevitable and the problem is to find techniques for effecting them promptly without loss of time and without duplication of effort. Experience seems to indicate that the ideal plan is one involving coordinate review and some division of labor. Under such a plan both the external and the internal review offices would examine a proposal concurrently. The external office would discover and pursue the issues which were important to it, leaving to the internal office the pursuit of issues more appropriately resolved internally.

A number of other questions might be discussed—for example, the proper location of the control office within the organization, its relation to the function of general statistical planning, its responsibility for detailed matters of form design, and so forth. But the above discussion

is sufficient to indicate the variety of problems involved in the development of this relatively new phase of administrative control within Federal agencies.

Much valuable experience is now accumulating through the functioning of the existing internal control units, and additional units may be established. Though much of the impetus toward internal control has come from the wartime expansion of the Federal statistical program, it is not unrealistic to hope that internal control units will survive the war on the basis of their tested usefulness. Too much should not be expected of them. They should not be thought of as a substitute for proper internal organization or for competent statistical personnel within their agencies. Rather they should be looked to for that coordination, perspective, and specialized knowledge of data-collection problems which it is their function to provide.

METHODS USED IN PROCESSING DATA FROM THE PHYSICAL EXAMINATION REPORTS OF THE SELECTIVE SERVICE SYSTEM

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The statistical program of the Selective Service System furnishes the data necessary to the planning and operation of its task of procuring manpower for the armed forces with the least possible disturbance to the Nation's economic and social life. This statistical work is essential in the three primary processes of Selective Service: (1) registration and classification in general, (2) occupational deferment, and (3) physical examination.[1]

The medical statistics part of the program is concerned entirely with the results of physical examinations and is based almost wholly on the reports of the physical examinations of registrants.[2] The medical data obtained are used (1) to supply states and local boards with the most current information concerning physical examinations and (2) to provide a basis for estimating the effects on manpower procurement of different levels of physical standards.

The initial emphasis of the medical statistics program was on research. At that time the main interest of Selective Service was in the rehabilitation of men rejected for military service and in forecasting the effect of the high physical standards in use during peace on the future war-time procurement of millions of registrants for the armed forces. The statistical needs of the System could best be served by a thorough understanding of the characteristics of the men physically examined for military service. An exhaustive study was therefore made of the information on the registrants' physical examination reports, and, although this research phase was just getting under way when the United States entered the war, the experience gained from it was invaluable when the work later became focused on administrative or program statistics.

THE RESEARCH PHASE

During 1940 and 1941 each registrant considered for induction was given a complete physical examination[3] by the local board physician

[1] See McGill, K. H., "The Statistical Program of the Selective Service System," this Journal, March 1944, Vol. 39, pp. 10–20.

[2] Broad aspects of the medical statistics program were outlined by Folk, O. H., "Selective Service's Medical Statistics Program," this Journal, December 1942, Vol. 37, pp. 425–429.

[3] Registrants with obvious defects, such as those with both arms or legs missing or those who were determined to be educationally deficient, were not always given a complete physical examination but Forms 200 were usually filled out for these registrants.

who recorded his findings on a Selective Service form entitled "Report of Physical Examination" and numbered DSS Form 200. If the registrant was found physically fit and subsequently given another complete examination at the induction station, the results were recorded on a War Department form designated as WD, AGO Form 221 which was entitled "Report of Induction of Selective Service Man."

The medical sections of both reporting forms were identical. In general, the left hand portion of the page provided separate lines for recording defects or diseases of specific parts of the body. Space was also provided for summarizing the registrant's defects in order of importance. The right hand portion was devoted to recording results of special tests and measurements.

Provisions were made for National Headquarters to receive from the local boards a copy of the Form 200 for every registrant physically examined. A copy of WD, AGO Form 221 for men rejected after induction station examination was received by the local boards and in turn transmitted to National Headquarters. The Selective Service System did not receive copies of WD, AGO Form 221 for inducted registrants during the period in which this form was in use.[4]

In consequence, the research phase of the medical statistics program centered around the processing of Form 200. Since approximately 84 per cent of the registrants forwarded by local boards for induction station examination were inducted, a fairly complete picture of the defects of Selective Service registrants examined during this period was available from Form 200. A brief outline of the way in which the report was prepared by the local boards will serve to indicate the type of data recorded.

Filling out Form 200.—When a registrant was notified to appear for local board examination, the local board clerk affixed the local board stamp with code on the form and entered the identifying and general information concerning the registrant (name, address, order number, race, birthdate, birthplace, mother tongue, occupation, and whether the registrant's residence was urban or rural). At the time the registrant presented himself for examination, he was entitled to make a statement of any defects he believed he had and was required to answer specific questions concerning his past medical history. These were recorded on the report and the registrant was required to sign his name to the statement certifying that the information was correct.

The local board physician then examined the registrant in accordance with the Selective Service regulations. Negative as well as positive

[4] In 1943, the Surgeon General's Office of the War Department, which did receive copies of WD, AGO Form 221 for inducted registrants, forwarded these forms to National Headquarters.

findings were recorded on Form 200 as the examination progressed. In addition, measurements such as teeth counts, visual and auditory acuity, pulse and blood pressure readings, and height and weight were entered. Blood and urine specimens were taken for the serological blood test for syphilis and urinalysis, respectively. A chest x-ray was usually taken if tuberculosis was suspected. In cases of unusual diagnostic difficulty or when the registrant appealed his classification as a result of physical examination, a partial or complete examination was also given by a specialist on the Medical Advisory Board and these findings were likewise recorded.

After the physical examination, the physician summarized the defects in order of importance and entered his recommendation concerning the registrant's availability for military service. In cases where he believed the registrant was not qualified for general military service, he recorded the defect or defects on which he based his decision. The local board considered the physician's recommendation and in most cases concurred, classified the registrant accordingly, and entered the class on the report.

The Forms 200 were transmitted to National Headquarters along with a transmittal sheet which listed the names and order numbers of the registrants whose reports were forwarded. These transmittal sheets, sent in duplicate, were checked against the forms received and one receipted copy ultimately returned to the local board. The statistical processing of the Forms 200 was begun at National Headquarters late in 1941.

Pilot study.—As a preliminary to processing the Forms 200 on a large scale, a set of codes, including a detailed one on medical defects, was developed. These codes were tested on 30,000 cases representing one and one-half per cent of the reports received through May 31, 1941. From this pilot study the adequacy of the codes and the relative informational value of the items on the schedule were determined. The results of this study were presented in Medical Statistics Bulletin No. 1, which was released by the Selective Service System in November 1941.[5]

Ten per cent sample study.—It was decided that the larger study on the defects of examined registrants should also be conducted on a sample basis. Forms 200 for all of the 6,441 local boards were to be included. Two problems were immediately apparent: (1) the time period to be covered and (2) the size of the sample.

From November 1940 through September 1941, the physical ex-

[5] See also Rowntree, L. G., McGill, K. H., and Folk, O. H., "Health of Selective Service Registrants," *Journal American Medical Association*, April 4, 1942, Vol. 118, pp. 1223–1227.

amination procedure followed by local boards in each state was uniform. From October 1, 1941, to the end of the year the procedure was in a state of change. Since the Forms 200 for registrants examined through September 30, 1941, had the advantage of being homogeneous with respect to physical examination procedure, it was decided that they should be used for the study. Accordingly, two files were set up—one for examinations made through September 30, 1941, and one for those made subsequent to that date. The reports were filed by state, county, and local board; and within each local board these reports were filed by the order numbers which had been assigned to the registrants as a result of the national lotteries of October 29, 1940, and July 17, 1941, on the first and second registrations respectively.

Reports from local boards indicated that Form 200 had been filled out for approximately 3,000,000 registrants during the period November 1940 through September 1941. Facilities were available for processing about 300,000 forms, which would represent a 10 per cent sample of these examinations, and would provide adequate medical data for the individual states. However, not all the physical examination forms had been transmitted to National Headquarters and the sampling ratio which had to be applied in order to obtain a 10 per cent sample varied from one local board to another. A count of the number of forms transmitted by each local board was therefore made.[6] After it had been determined that the number of Forms 200 received was at least 85 per cent of the number of forms prepared in each state, the sample for each local board was obtained by applying the following formula:

$$\frac{P}{10} = \sum F_i R_i \qquad i = 1, 2, 3.$$

where P = the number of forms reported to have been filled out by the local board

F_i = the number of forms transmitted to National Headquarters by the local board

R_i = sampling ratio

and $F_{i+1} = F_i(1 - R_i)$.

Thus, if the first sampling ratio were $\frac{1}{9}$, every ninth form was drawn from the file. For most local boards, two sampling ratios were sufficient to obtain the desired sample. No more than three sampling ratios had to be computed for any local board.

[6] As a preliminary step in counting the Forms 200, duplicate copies and copies representing more than one examination of the same registrant were stapled together and counted as one form. Also forms for registrants rejected for moral or administrative reasons (prison record, dishonorable discharge from the Army, Navy, etc.) were discarded if no physical examination had been made.

Processing the forms.—In processing the forms for the 10 per cent sample, coding boxes were overprinted on the left hand margin of the form. Specific instructions on how to code the various items were prepared. As different coding problems arose supplements were issued. The items coded fell roughly into four groups: (1) general information, (2) results of special tests, (3) results of special measurements, and (4) medical defects.

Coding general information.—The items included in this group were: local board number, order number, race, occupation, size of city, birthplace, birthdate, month last seen by physician, date of examination, physician's recommended classification, and the action taken by the local board. Some of these items were precoded; for example, the local board stamp which appeared on each form included a code of 8 digits—2 for the state, 3 for the county and 3 for the local board number. This was a standard code used for processing other Selective Service documents.

Manuals and indexes were prepared for coding occupation, size of city and birthplace. In order to set up the occupational index, it was necessary to analyze entries on the 30,000 forms of the pilot study to see what degree of detail should be utilized and what entries should be listed. A two-digit code convertible to those in use by other government agencies was adopted and an alphabetical index and a numerical index were developed for this code.

Coding the results of special tests.—The results of chest x-ray, serologic tests for syphilis, and urinalysis were coded for each registrant. The difficulties encountered in coding chest x-ray were mainly concerned with determining whether a chest x-ray had been taken, since these x-rays were not taken routinely for all examined registrants. On most forms, however, there was some statement as to whether the registrant had any lung pathology. A list of entries was therefore drawn up and the coder was instructed as to which of these indicated x-ray findings.

Similar difficulties were raised in interpreting results of urinalysis. In addition, many cases showed that more than one serologic blood test for syphilis had been made and a table had to be established indicating the correct code when the results of these tests were different.

Coding the results of special measurements.—These items included measurements of vision, hearing, pulse, blood pressure, girth, height, weight, and teeth counts. Height, weight and girth offered no problems in coding.

Hearing and vision measurements were recorded in a variety of ways and detailed instructions as to the interpretation of the measurements had to be developed. For instance, hearing measurements were recorded

sometimes in descriptive terms such as "hears nothing," "partially deaf." In other cases results of tests other than those prescribed in regulations were entered and these results had to be converted into terms of standard tests. Similar difficulties arose in the coding of vision measurements.

Pulse and blood pressure coding offered different problems. An analysis of pulse reading showed that almost all were divisible by 2 or 4. This indicated that many physicians took the number of pulse beats in 15 seconds or 30 seconds and multiplied by 2 or 4 to get the number per minute. Blood pressure readings were almost all divisible by two. Consequently, instead of coding each pulse or blood pressure reading, the code set up represented a grouping of two consecutive numbers. Thus a pulse or blood pressure reading of 100 or 101 was coded 31, 102 or 103 was coded 32.

The examining physician or dentist recorded the dental count on a chart which was part of the form. Different symbols were used to record the condition of specific teeth. Thus if a tooth (represented by a number) was encircled it meant that the tooth was carious. In many instances the tooth chart was not filled out or the findings were written below the chart. Methods had to be worked out for standardized coding. As in the case of vision and hearing measurements, qualitative entries had to be translated into quantitative terms.

Setting up the medical defect code.—The Army regulations (Mobilization Regulations 1–9), which prescribe standards for men entering the military service, determined to a large extent the broad outline of the medical code. Also, since the items referring to the physical examination on the Form 200 followed the subdivisions of the Army physical standards it was expedient to adopt these groupings. The skeleton of the code consisted of 27 broad defect groups representing the various parts of the body and certain specific diseases or defect entities as shown in Table I.

No specific terminology was prescribed in the physical standards for recording the registrant's defects on the physical examination form. Although many physicians adhered to the language of the MR 1–9 they were free to describe defects in any language they chose and as a result there was wide variation in the nomenclature used. This was to be expected since the defect entries represented the findings of approximately 28,000 examining physicians and 10,000 examining dentists in the 6,441 local boards.

In setting up the rubrics two types of problems arose: (1) What detail should be carried under each of the broad groups? (2) How should the titles be worded and what defects should they include?

TABLE I

CODES FOR THE 27 BROAD DEFECT GROUPS USED IN PROCESSING FORMS 200

Defect group	Code	Defect group	Code
Eyes	001–049	Syphilis	440–459
Ears	050–079	Venereal diseases other than syphilis	460–479
Teeth	080–109	Skin	480–529
Mouth and gums	110–129	Hemorrhoids and other rectal defects	530–559
Nose	130–149	Varicose veins	560–579
Throat	150–169	Mental deficiency and mental disease	580–639
Lungs	170–209	Neurological	640–669
Tuberculosis	210–229	Musculoskeletal	670–809
Cardiovascular	230–299	Feet	810–829
Blood and blood-forming	300–319	Endocrine disturbance	830–859
Hernia	320–349	Cancers, tumors	860–899
Kidney and urinary system	350–379	Infectious, parasitic and epidemic diseases	900–919
Abdominal viscera	380–399	Other diseases, defects and anomalies	920–999
Genitalia	400–439		

An analysis of the entries made on the 30,000 forms of the pilot study indicated that the defects were recorded in sufficient detail insofar as the end result of the pathologic process was concerned but not with respect to the cause of the defect. For example, underweight was often recorded as a defect by the physician without mentioning whether this condition was due to malnutrition or endocrine dyscrasia. It was therefore impracticable to adopt any nomenclature which was as detailed as that used in hospitals and in research institutions. Thus, the decision was made to include rubrics which described the end-result rather than the etiology, although in some specific cases, such as defects resulting from syphilis, the etiology was given preference.

Since the program was set up largely for research purposes it was advisable to carry as much detailed information as was available for certain defects. For example, hernia was subdivided into such titles as direct inguinal, indirect inguinal, abdominal, etc. However, it was not feasible to carry refined diagnoses such as a specialist would record since this information would not be available in the majority of cases.

Conferences with members of the Medical Division in National Headquarters and with leading specialists in medicine and medical statistics were held to discuss how the titles should be worded and what defects they should include. The titles adopted were not limited to exact medical terminology but were based largely on the entries made by the physicians on the 30,000 forms used in the pilot study. With few exceptions, a code was established only when the frequency of the entry warranted it. Thus, a title was reserved for "one leg shorter than other" because of the frequency with which this entry was made.

The greatest difficulty was encountered in setting up the codes for mental disease. This was due to the variety of classifications in the field. The entries on the forms were extremely varied and not too concise with the result that the codes set up for mental disease were relatively less specific than for other groups.

In those cases where confusion in coding was anticipated, definitions were established describing what types of defects should be included in the rubric. The major problems of overlapping codes were thus settled in advance of the actual coding operation.

A medical code of 515 rubrics was adopted. Blocks of three-digit numbers were assigned to each of the 27 broad defect groups shown in Table I. The first two digits specified the broad defect group; for example, the numbers 05–07 were assigned to ear defects. The third digit designated specific diseases, defects, or locations of the disease or defect. Thus, 050 was assigned to descriptions of bilateral deafness, 051 to unilateral deafness, 052 to defective hearing, etc. In most instances the last rubric in each broad defect group was reserved for defects not elsewhere classifiable in the group, as 079 for "other ear defects." Certain code numbers were left blank in each block to cover expansion should this become necessary.

Medical defect coding.—In order to maintain uniformity in the coding of medical entries, extensive manuals had to be developed. Precise medical terminology was not a problem in setting up these manuals. The problems arose in connection with the many entries on the forms which were couched in idiomatic expressions or lay language and in the fact that many entries were symptoms instead of diagnoses.

The coding manual for defects was based on the medical entries which had been copied from the 30,000 forms referred to above. One of the manuals listed in alphabetic order the key words and permissible modifiers along with the code number; the other manual, numerical in arrangement, listed permissible entries under each rubric. Key words consisted of standard diagnostic terms, parts of the body, or the cause of a disease or defect. The modifier expressed cause, degree of disability, or stage to which the condition had progressed. Permissible modifiers were often enclosed in parentheses; instructions to the coders were enclosed in brackets.

Entries in the alphabetical index followed essentially four patterns:

(1) Disease or defect entities not likely to have modifiers, such as:

273 Buerger's disease

(2) Diseases or defects likely to have a few common modifiers, such as:

355 Pyelitis (acute, chronic) (low grade, mild, moderate, severe)

Note: The code number 355 could be assigned to "pyelitis" or to pyelitis with any combination of the modifiers in the parentheses.

(3) Diseases or defects likely to have many permissible modifiers such as:

013 Trachoma (including following locations)

bilateral	left eye	O. S.
both eyes	O. D.	right eye

(including following descriptive terms)

active	chronic conjunctivitis	old
acute	history of	scars
chronic	incipient	scars from ulcer
chronic blepharitis	mild	slight scarring of conjunctiva

Note: The code number 013 could be assigned to "trachoma" with or without any combination of the locations and descriptive terms.

(4) Diseases or defects the degree of which determined the code number to be applied, such as:

Pes planus [if no descriptive term is given code 829]

[When followed by one and only one of the following descriptive terms, code in accordance with the list below]

821 a little	829 pain(ful) (on standing)
829 asymptomatic	822 partially
823 bad(ly)	821 plus one
823 complete(ly)	822 plus two
823 definite(ly)	823 pronounced
823 eversion (with)	
.	.
.	.
.	.
.	.
821 plus one	823 with pronation

Setting up indexes in accordance with these patterns eliminated repetitious terms and therefore had the advantages of saving space and providing greater readability. It also had the advantage of giving the coders a broader understanding of the content of the various medical rubrics.

Coders were instructed (1) to read each medical entry on the form

in its entirety, (2) to select the key word in each entry which referred to a part of the body or to a disease, and (3) to look up each key word in the alphabetic index. If the coder could match, word-for-word, the entry on the form with terms listed in the index, the indicated code number could be assigned. Forms thus coded were given to another coder who verified the code number assigned by using the numerical index. It should be noted that this procedure was particularly verbalistic and that coders were not obliged to know the meaning of the entries that were coded. Supervisors had access to text books on medicine and the medical dictionary which aided greatly when problems arose in the coding of particular defect entries. Entries which the supervisor could not code even with these aids were usually referred to the physicians in the Medical Division of National Headquarters. The entries which were difficult to code were recorded on cards and a file of these maintained for reference and possible revision of the index. In some cases the registrant's own statement of his physical condition which was recorded on the form served to help in coding the registrant's defects. This was also true in those cases where statements from hospitals or sanitoriums had been stapled to the form by the local board clerk.

A code number was assigned for each defect on the form but only selected codes were copied in the superimposed coding boxes reserved for defects. The code for the registrant's principal defect was entered in the first of these boxes. The principal defect of a registrant found qualified for general military service was the first defect listed on the form by the physician in his summary of defects. For a registrant found not qualified for general military service, the principal defect was the first defect entered in the local board classification section, the physician's certification section, or in his summary of defects.

Selection of the final code numbers for defects followed three general principles:

(1) Certain codes referred to medical defects which could be listed both in words and in measurements. Code numbers for these word entries were followed by an "X" (as "004X"—partial blindness), to indicate to the coder that the code number (without the "X") was to be selected as a final code only (a) in those cases where the defect was recorded as the principal defect and (b) in those cases where the defect was secondary and the measurements were not given.

(2) When the physician entered a vague description of a defect or a non-specific description such as "kidney trouble" in his summary of defects or in the certification section, and a more specific description such as "chronic nephritis" appeared above in the space for recording

kidney defects, the code number for chronic nephritis was used instead of the code number reserved for unspecified kidney defects.

(3) Often, information entered in one part of the form was duplicated elsewhere in different words and it became necessary to set up safeguards against coding the same condition two or more times for a registrant. Therefore, a procedure was established whereby only one defect was coded for each broad defect group. For instance, if a registrant with rheumatic heart disease was also recorded as having a mitral systolic murmur, cardiac hypertrophy, and dyspnea on exertion, only rheumatic heart disease was coded, since all these conditions are part of the rheumatic heart disease picture. At the time the medical defect codes were developed, all of the defect titles in each broad defect group of this code were ranked in order of preference and listed on a priority chart for the use of the coders. Diagnostic terms headed the list, followed by less serious conditions and less inclusive terms. Thus, in any broad defect group, only the term which was most descriptive of the registrant's condition was finally coded. Under this procedure a registrant could have as many defects coded as there were broad defect categories.

Punch card.—After the defect codes had been selected, entered in the superimposed coding boxes and verified, they were transferred to punch cards. Chart I is a facsimile of the punch card used. A separate card was punched for each selected defect. Thus if a registrant had three defects he would have three punch cards. The first card, called the master card, contained the registrant's principal defect. All other cards were called trailer cards and had the same information as the master card with the exception that each carried a secondary defect.

The advantage in having one card for each defect was that it facilitated counting all recorded defects, whether principal or secondary. It also made possible a detailed study of registrants with certain types of defects. The disadvantage was that it made difficult the study of the association of defects in any one registrant except by a complicated tabulating procedure.

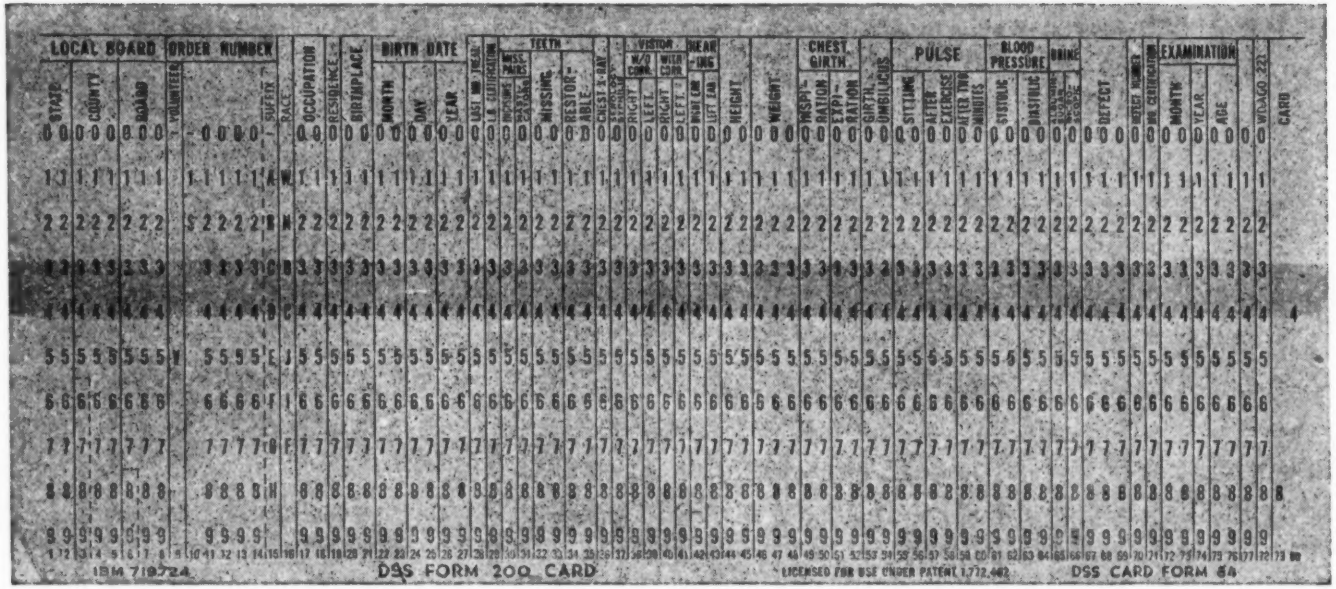
Results.—The punch cards have been tabulated to secure information by race, on the defects of registrants in relation to local board classification, occupation, city size, and data on the results of special tests and measurements. The following is a partial list of the tables prepared:

(1) Principal defect and all defects in relation to local board classification and age,

(2) Occupation in relation to local board classification and principal defect,

CHART I

PUNCH CARD USED IN PROCESSING THE 10 PER CENT SAMPLE OF DSS FORM 200



(3) All recorded defects by city size and local board classification,
(4) Height by weight by local board classification,
(5) Vision measurements in relation to eye defects,
(6) Teeth counts in relation to hearing measurements,
(7) Pulse rate in relation to blood pressure readings.

These tabulations have been the basis for Medical Bulletin No. 2 in which the data presented are mainly concerned with the defects of examined registrants. They will also be used in connection with other Medical Bulletins on the results of special tests and measurements. The information has likewise been applied for purposes of estimating (1) the number of registrants with remediable defects, (2) the number of registrants who would be available for service in the armed forces if registrants with limited service defects were inducted, and (3) the probable effects of changes in physical standards on the procurement of military manpower.

THE ADMINISTRATIVE PHASE

With the entry of this country into the war, the complete physical examination of a registrant at the local board was replaced by a routine physical inspection. Under the revised regulations, a registrant could be disqualified for military service after this inspection by the local board physician only if he had a manifestly disqualifying defect. A list of such defects, 141 in number, was made available to each local board physician as a guide.

If the registrant passed his local board examination and was subsequently forwarded to the induction station, he was given a complete physical examination by specialists there. The use of DSS Form 200 and WD, AGO Form 221 was discontinued and in its place a single form was introduced—DSS Form 221, Report of Physical Examination and Induction. The new form provides space for the results of both the local board inspection and the induction station examination.

Filling out DSS Form 221.—When the registrant is notified to appear for local board examination, the local board clerk fills out the first page of the form, consisting of (1) identifying information such as the registrant's name, local board, order number, address, birthdate, and race; and (2) socio-economic data—his education, marital and dependency status, and occupation and employment status—which are obtained from the registrant's classification questionnaire, DSS Form 40, or from later information in the registrant's folder, DSS Form 53, when it is available.

The DSS Form 221 is sent to the local board physician, whose examination includes drawing a specimen of blood from the registrant

for a serological test for syphilis and entering remarks concerning his general impression of the registrant's physical fitness. If the registrant has a manifestly disqualifying defect, this defect is also recorded by the physician. The local board then classifies the registrant and the clerk enters his classification on the DSS Form 221.

If the registrant is forwarded to the induction station he is given a complete physical examination there which includes special tests and measurements. The section provided in the DSS Form 221 for the recording of induction station findings is almost identical with the physical examination section of DSS Form 200, including the summary of the registrant's defects in the order of their importance.

After the registrant is examined by the specialists at the induction station, the chief medical examiner reviews all the findings and specifies for what type of service the registrant is qualified. If the registrant is not qualified for general service the defects upon which the decision is based are specified. The action taken at the induction station, whether the registrant is rejected or inducted, is also entered on the form. The final section of the DSS Form 221 is devoted to the local board's reclassification of the registrant after his induction station examination.

DSS Form 221 is filled out in quadruplicate and one copy of the form is transmitted by the local board through State Headquarters to National Headquarters for all registrants physically examined, whether rejected at the local board or examined at the induction station. The transmittal sheet is similar to that which was used for forwarding DSS Form 200 to National Headquarters.

Several advantages accrue from the use of one form for both local board and induction station examinations: (1) it provides National Headquarters with a complete record of the physical examinations and classifications of both inducted and rejected registrants; (2) it makes it easier for the induction station examiners to review the results of the local board physical examination; (3) it simplifies local board and National Headquarters' files, since only one form is required for each registrant; and (4) it makes relatively detailed data available on the socio-economic status of the registrant in relation to the outcome of the physical examination, which was not the case with DSS Form 200 or WD, AGO Form 221.

Processing the forms.—For the operational and planning purposes of the entire Selective Service program it is necessary to process the DSS Form 221 statistically with a view to making periodic reports to the states and local boards on their own physically examined registrants. In order that the reports to the states be representative of the registrants

examined and also as current as possible, local boards must transmit the National Headquarters' copy of DSS Form 221 promptly. Weekly receipt records are therefore kept on the number of these forms transmitted by each state and a cumulative monthly "completeness of reporting" index is computed. This index consists of the ratio of the number of DSS Forms 221 received to the total number of men reported as having been examined from the time the form was first used to the end of the current month. States with low indexes of receipt are notified to that effect. Thus, the forms transmitted each month represent some examinations made in previous months. In the statistical processing of the forms they are handled by month of receipt and not by month of examination.

During the first three months in which DSS Form 221 was used, all the forms received were processed in a manner similar to that for DSS Form 200, that is, the detailed medical code was used, and most of the socio-economic data and also the results of special tests and measurements were coded. However, this procedure did not produce enough processed forms to serve administrative needs for medical data, because of the large number of items coded and the detailed medical code used. The decision was therefore made to code only those socio-economic terms important for administrative purposes, to eliminate the coding of special tests and measurements and to abridge the medical defect code.

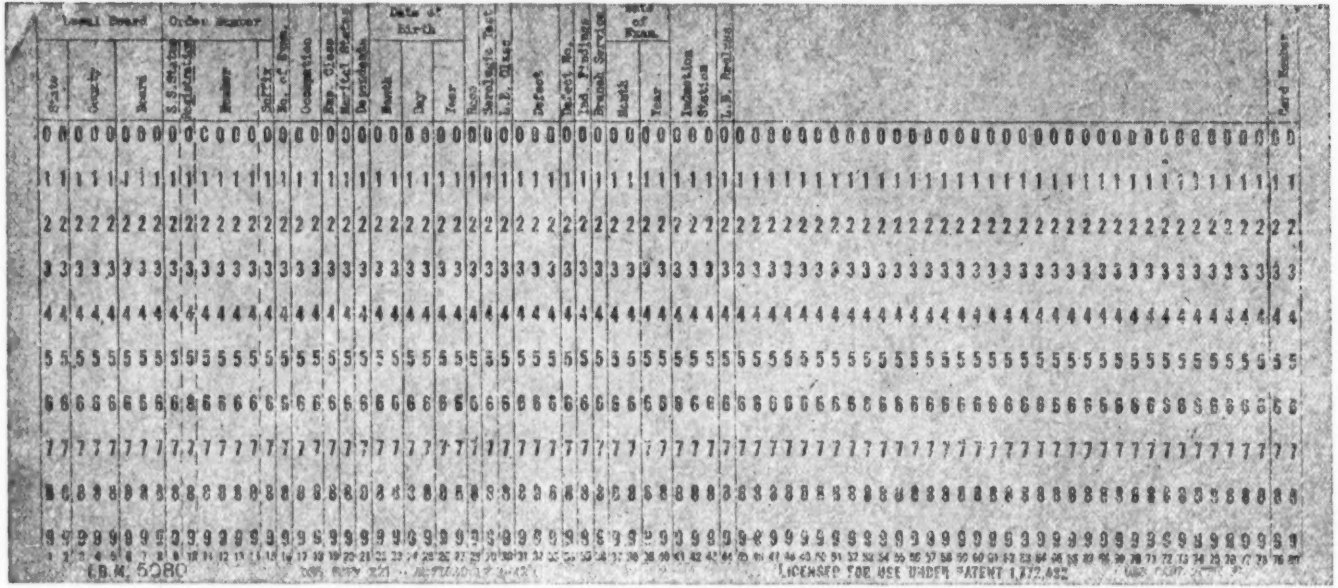
In view of the increasing numbers of registrants examined each month and the resulting increase in the number of DSS Forms 221 received, it was also decided that only a 25 per cent sample of the forms would be coded. Accordingly, as each shipment of forms is received, every fourth form is withdrawn for processing.

In processing the forms it has been found that from three to five per cent of the sample are reports for registrants who have passed the local board physical examination but are not sent to the induction station because they are deferred for occupational or dependency reasons after the local board examination. Inasmuch as the purpose of processing the DSS Forms 221 is to obtain data on the defects of inducted or rejected registrants, and also since only a screening examination is given at the local board, the DSS Forms 221 for these registrants are not processed.

Coding.—The identifying and socio-economic data which are coded include: registrant's local board, order number, race, birthdate, marital and dependency status, occupation and employment class, number of examination, result of examination and date of examination. Most of these items are coded in much the same way as they were on DSS Form

CHART II

PUNCH CARD USED IN PROCESSING THE 25 PER CENT SAMPLE OF DSS FORM 221



200. The only medical data other than the registrant's defects which are coded are the results of serologic blood tests for syphilis.

In order further to speed up processing, a defect code of only 100 rubrics is used. This code was drawn up in such a way that the 515-rubric medical defect code which was used in processing Forms 200 is readily convertible to it. Only rubrics which had large frequencies, as revealed in the processing of Form 200, and those which were of administrative interest were retained. The code numbers of this abridged code were so arranged that the first two digits specify the broad defect group. Thus 00 represents eye defects, 01 ear defects, 02 teeth defects, etc. The third digit specifies the defect; thus, for endocrine defects, 241 denotes diabetes mellitus, 242 Fröhlich's syndrome, etc. Certain numbers were left open for possible expansion of the code. As in processing the Forms 200 the rule has been continued to code only one defect in each broad defect group. To facilitate this choice, the code numbers in each broad defect group were arranged in decreasing order of preference, i.e., the more serious defect for coding purposes was the one with the lower code number. Word-for-word coding was discontinued and consequently the indexes set up for the abridged code do not contain as many entries as those for the 515-rubric code.

The coding of medical defects on DSS Form 221 differs from that on DSS Forms 200 in that only those defects listed in the "physician's summary" are coded. Defects listed in the separate items are referred to and coded only when they are more specific than the defect described in the summary. Thus if a physician recorded "Eye trouble" in the summary of defects and the entry in the space provided for recording eye defects was "chronic conjunctivitis" the more specific entry is coded. The principal defect, however, is selected in much the same manner as on the DSS Form 200.

Punch card.—The DSS Form 221 has printed code boxes on its left-hand margin which bear numbers corresponding to the items of the form, to facilitate coding entries. As in the case of DSS Form 200, the number of cards punched for each registrant depends on the number of defects coded. The master card contains the principal defect; the trailer cards have the secondary defects.

Results.—The master cards have been used to prepare (1) special reports for administrative purposes within National Headquarters and (2) periodic tabulations for the various states and local boards. Both types of information cover the principal defects of inducted and rejected registrants. In addition, master and trailer cards have been tabulated in combination to furnish data on the prevalence and the association of defects. During the period April 1942 through Septem-

ber 1943, approximately 1,800,000 DSS Forms 221 were processed and more than 2,400,000 cards prepared.[7] Examples of the more important tabulations, all of them specific for race, are:

(1) Principal defects of rejected registrants in relation to age and occupation,
(2) Principal defects of registrants rejected at local boards, and rejected or inducted at induction stations,
(3) Occupations of examined and inducted registrants,
(4) Marital and dependency status of examined and inducted registrants,
(5) Age of examined registrants in relation to Selective Service classification,
(6) All recorded defects of examined registrants in relation to Selective Service classification,
(7) Association of defects among rejected registrants.

These tabulations form the basis for furnishing to National Headquarters (1) current reports on the defects of examined registrants; (2) estimates on the defects of registrants not yet examined; and (3) monthly estimates of defects of registrants in Class IV-F. The latter estimates have been widely applied because of the increasing need for salvaging, as physical standards have changed, all Class IV-F registrants who could qualify for service in the armed forces.

The more significant of all this information on the wartime physical examination experience of Selective Service registrants is presented in confidential state releases. The data are also incorporated in Medical Statistics Bulletin No. 3 and in a monograph on the medical aspects of the Selective Service System which is being prepared for later release.[8]

From this report on the methods used, it is apparent that, in planning for the processing of the physical examination reports, changes in regulations and revisions in physical standards were anticipated. In addition, the medical and socio-economic codes which were used were based on actual entries on the physical examination reports rather than on any standard codes then existing. All this has resulted in a flexible medical statistics program for Selective Service which could be adapted to the changing needs of the System by building on the fundamental codes and procedures of the first, or pilot, study.

[7] Since November 1943, the Forms 221 have been forwarded to the National Headquarters of the Selective Service System through the Surgeon General's Office of the War Department which processes a sample of these forms. Duplicate copies of the punch cards are furnished to the Selective Service System for tabulating purposes. In general, the processing methods now being used by the Surgeon General's Office are adaptations of those described herein for Forms 200 and 221 and were adopted by a joint committee of the War and Navy Departments and the Selective Service System.

[8] See also Rowntree, L. G., McGill, K. H., and Edwards, T. I., "Causes of Rejection and Incidence of Defects Among 18 and 19 year old Selective Service Registrants," *Journal American Medical Association*, September 25, 1943, Vol. 123, pp. 181–185.

BENEFITS AND BENEFICIARIES UNDER SOCIAL INSURANCE AND RELATED PROGRAMS

By Franklin M. Aaronson
Social Security Board

The enactment of the Social Security Act in 1935, and the subsequent amendments in 1939, marked a major change in the approach to the problems of economic insecurity in this country. Previous to this legislation, which established a national social insurance system as a means of meeting the problems of loss of income resulting from old age, death, or unemployment, relief programs of various types were the main support of those who had suffered loss of income and resources.

With the enactment of the Social Security Act, social insurance became for millions of families the first line of defense against economic insecurity, while relief programs became supplementary in character. Table I gives some idea of the relative importance of these two types of programs in total income payments for 1942 and 1943.

TABLE I
INCOME PAYMENTS TO INDIVIDUALS, 1942 AND 1943*
(In billions)

	1943	1942
Total income payments†	$142.2	$116.6
Compensation of employees	100.7	79.7
Entrepreneurial income net rents and royalties	27.7	23.9
Dividends and interest	10.1	9.4
Relief	1.0	1.7
Social insurance and related programs‡	1.7	1.8
Military allowances	1.0	.1

* Source—U. S. Department of Commerce 1943 preliminary.
† Includes Veterans' bonus payments; less than $50 million in each year.
‡ For programs included see Table II.

In 1942, for the first time, payments under social insurance and related programs exceeded payments under relief programs, even though payments under the Social Security Act had by 1942 attained only a small proportion of their potential volume. While the effect of full employment has probably had a somewhat more drastic effect on relief payments than on total social insurance and related payments, it is doubtful whether relief payments will again exceed payments made under social insurance and related programs, unless there is a serious and prolonged depression during the immediate post-war period.

However, the shift in the method of meeting the problems of economic insecurity is not as yet complete—large segments of the popula-

tion are not included under the Social Security program nor are several important risks included in the provisions of the Act. Thus self-employment, domestic service, employment in agriculture, nonprofit organizations, Federal, state, and local government, and some miscellaneous groups, are specifically excluded from the Act, while the risks of disability and injury are not included as insurable risks.

In administering the Social Security Act the Board has a responsibility for studying and making recommendations as to the most effective methods of providing social security protection. Such a responsibility involves an analysis of all Federal, state, and local programs which make use of social insurance techniques to offset income loss. For several years, as part of the over-all program directed toward this objective, the Board has been developing an integrated series of statistical data on the number of beneficiaries under programs using social insurance techniques and the amount of payments to these recipients.

Such a series provides an answer to two related questions of interest to the Board in the formulation of plans for strengthening social security protection. These questions, which naturally follow from the limitations of the present Act are:

1. How many individuals excluded under the Social Security Act are covered by related programs and what is the extent and character of protection under such programs?
2. How many systems which provide insurance against risks not included in the Act are in operation and what is the extent of protection under such systems?

Combining data for these systems with data relating to programs operating under the Social Security Act, it is possible to obtain some measure of the over-all protection afforded by social insurance and related programs.

The following pages discuss some of the problems involved in this project and present quantitative measures of the extent of social insurance protection in this country today. It is thought that the presentation of these data in the JOURNAL will make available to statisticians, in general, information which has been known to a somewhat more limited group of persons working in the field of social security.

In the integrated social insurance statistics series a social insurance program has been defined as "a public program making payments to covered workers or their dependents on the basis of previous employment or service records, according to formulas specified in the laws, with payments financed from contributions of employers, employers and employees, or from public funds." After considering various alternatives the series has been entitled "social insurance and related programs" to make allowance for the systems which meet the test of a social insurance system as defined but have additional attributes as

well, such as governmental retirement systems which not only provide protection against economic insecurity but form an important part of personnel policy.

The definition excludes from the series systems operating under private auspices and relief programs under which payments are based on need, rather than on employment or service records. Included under the definition are all public systems making retirement, disability, or survivor payments or payments for periods of unemployment. The systems thus included, together with the groups covered, are as follows.

Program	*Covered groups in 1942*
Old-Age and Survivors Insurance	Approximately 46 million industrial and commercial workers
Railroad Retirement	Approximately 2 million railroad workers
Federal Civil Service Retirement	Approximately 3 million Federal Government employees
Other Federal Contributory Retirement	Employees of TVA, Comptroller General's office, Foreign Service of State Department, Federal Reserve Board, civilian employees of Naval Academy—approximately 25,000
Federal Noncontributory Retirement	Members of regular military establishment, Public Health, Coast and Geodetic Survey, Federal Judiciary—no estimate of number covered is available
State and Local Government Retirement	About half of all state and local government employees—approximately 1.7 million covered.
Veterans' Pensions	About 10 million members of armed forces of World War II, plus beneficiary veterans and survivors of veterans of previous wars
Workmen's Compensation	No estimate of number covered is available
State Unemployment Compensation	Approximately 41 million industrial and commercial workers
Railroad Unemployment Insurance	Approximately 2 million railroad workers

It should be noted that considerable duplication in the number of workers occurs in this table. Thus, of the 45 million workers who earned some taxable wages under the OASI system in 1942, approximately 41 million were also covered by the state unemployment compensation programs and a considerable number by the state workmen's compensation laws. Other duplications are possible during the course of a year or over a longer period as workers shift from one type of covered employment or service to another type.

While there will be no attempt to analyze the provisions of these

systems in this article it should be noted that the protection afforded by the different systems varies considerably—thus some employees enjoy retirement, disability and survivor protection while workers covered by other systems have protection against only one or two of these contingencies; again there is considerable variation in the benefit provisions among programs insuring the same risk under different state laws.[1]

The relative importance of social insurance and related payments in the total flow of income payments provides a basis for evaluating the effectiveness of these programs in meeting the problem of income loss. It also affords an opportunity for judging the interrelationships between social insurance and relief payments and the various other types of payments. In order to provide a basis for this type of analysis, the Social Security Board has made use of the income payment series of the Department of Commerce which includes data on social insurance and relief payment furnished by the Board (see Table I). In order to make the Commerce series, as published, more nearly conform to Social Security Board needs, certain adjustments are made in the Commerce data, as shown in the following tabular summary.

INCOME PAYMENTS TO INDIVIDUALS

As published by the Department of Commerce	*As published by the Social Security Board*
Total*	Total*
Wages and salaries	Compensation of employees*
Total	Wages and salaries
Work relief	Other labor income
Direct and other relief	Relief
	Work
	Direct and other relief
Social security benefits and other labor income (incl. military allowances)	Social insurance and related payments
Dividends and interest	Dividends and interest*
Entrepreneurial income, net rents and royalties	Entrepreneurial income, net rents and royalties*
Veterans' bonus	Veterans' bonus
	Military allowances

* Adjusted for seasonal variation.

[1] See articles in the following issues of the *Social Security Bulletin:*
March 1940—"Social Insurance Payments in the United States"
April 1941—"Benefits and Beneficiaries Under the Civil Service Retirement Act"
January 1942—"Workmen's Compensation Benefits in the United States, 1939 and 1940"
January 1942—"Federal Contributory Retirement Systems Other Than Civil Service"
November 1942—"Pensions and Compensation to Veterans and Their Dependents"
July 1943—"State and Local Employees Covered by Government Retirement Systems"

It will be noted that in the Commerce series work relief is included in wages and salaries; and other labor income, which includes allowances to members of the armed forces, industrial pensions, and directors' fees, is included with social security benefits. In the Social Security Board's adjusted series, work relief is subtracted from wages and salaries and included under relief, while other labor income is separated from social security benefits and other labor income and added to wages and salaries to get compensation of employees. These shifts in classification provide, for Social Security Board purposes, a clearer distinction between social security and other income payments. Data are available in the Board on both a seasonally adjusted and unadjusted basis; only the seasonally adjusted data are published in the *Social Security Bulletin* each month.

BENEFIT PAYMENT DATA

Tables II and III present the latest information available concerning payments made under the various social insurance and related programs in this country. Table II presents annual data and contains

TABLE II

SOCIAL INSURANCE AND RELATED PAYMENTS TO INDIVIDUALS IN THE UNITED STATES, 1942 AND 1943
(Amounts in millions)

Type of payment	1943	1942
Total	$1,703	$1,844
Retirement, disability, and survivor	1,622	1,494
Old-age and survivor insurance	173	137
Railroad retirement	133	129
Federal retirement	162	150
Civil service	91	81
Other Federal contributory*	1	1
Federal noncontributory†	70	68
State and local government‡	325	309
Veterans' pensions	452	441
Workmen's compensation	377	328
Unemployment insurance	81	350
State unemployment insurance	80	344
Railroad unemployment insurance	1	6

* Includes retirement systems for employees of TVA, Federal Reserve Board, Office of Comptroller General, Foreign Service of State Department, and civilian employees of Naval Academy.

† Includes retirement systems for members of regular military establishment, Public Health Service, Coast and Geodetic Service, and Federal Judiciary.

‡ Estimates of Department of Commerce. Exceed SSB estimates by approximately $100–$150 million due to inclusion of payments made by systems making service-connected disability payments only (analogous to workmen's compensation payments); payments made under private endowment plans; payments made under plans providing for purchase of annuities through private insurance companies. Commerce estimates, included here in order to be consistent with figures in Table I, will be revised in line with recent SSB estimates.

statistics on some programs not included in Table III where data are on a monthly basis. For the programs omitted from the monthly series—workmen's compensation, state and local government retirement systems, and Federal contributory and noncontributory retirement systems other than the Civil Service Retirement system—no monthly reported data are available on a Nation-wide basis. As explained in more detail later, the Social Security Board has made annual estimates for the first two of these programs, and for the other programs data on an annual basis are available from published sources. The data presented in Table III are obtained from the agencies responsible for the administration of the programs and are used by these agencies for administrative purposes. While the change in payments from month to month under all except the unemployment insurance programs is slight, the data are compiled and presented on a monthly basis for several reasons. First, one important use of the data is in connection with monthly income payment estimates; second, for several programs the agency reports are on a fiscal year basis and they are here made available by months for adjustment on either a calendar or fiscal year basis; third, the wide variations in unemployment insurance payments cause the total to change considerably from month to month thus necessitating a monthly series for uses where the current situation is of importance; fourth, there is a steady upward trend in retirement disability and survivor statistics which is of interest to persons working in the field of social security.

The figures for all programs represent payments to individuals and exclude the cost of administering the programs. While it would have been desirable to have all payment data on a disbursement basis, variations in the accounting procedures of the various agencies made this impossible. Thus payments under the various programs are represented by amounts certified to the Secretary of the Treasury, and by checks issued, as well as by actual disbursement data. Insofar as possible, figures are on a net basis; that is, adjustments have been made for cancellations, voided checks, and for underpayment and recoveries of overpayments.

These data have been developed in cooperation with the various agencies administering the programs, or in the case of certain programs not under one agency, by means of estimation from available data. For each program in Table II, except the workmen's compensation and state and local government retirement systems, it was possible to obtain the payment figures from a central agency. The problem in such instances was to secure from these different agencies, data which would

be on a comparable basis. Inasmuch as the benefit and beneficiary data are obtained under the direction of different agencies, and are in most cases a by-product of the administrative process, they naturally differ in certain respects. An examination of the footnotes to the tables will indicate the necessary qualifications to be used in the interpretation of the figures.

For several programs there is no central agency which administers the program; the administration is in the hands of many agencies scattered throughout the states. Thus the state unemployment compensation and workmen's compensation programs operate under state laws and state and local retirement systems operate under state laws and local ordinances. For the state unemployment compensation figures the Social Security Board obtains reports from each of the states and thus is able to compile information on a national basis. Inasmuch as there is no central collecting agency for the other two programs it has been necessary to make a complete survey of available statistics for these programs in order to build up the data to a national level. A brief discussion of the methods used in preparing estimates for these programs is presented here, inasmuch as for these programs the statistics were not developed in cooperation with any one agency but represent essentially the work and responsibility of the Social Security Board.

Estimates of workmen's compensation benefit payments.—Reports of state workmen's compensation were first examined as a possible source of workmen's compensation benefit statistics. It was found that while such reports provide data in far greater detail and variety than any other source, lack of comparability in the statistical data prevented their use as a basis for national aggregates or for comparable state data.

The most nearly complete and comparable statistics on the national volume of workmen's compensation benefits paid each year are to be found in: *Spectator, Premiums and Losses by States,* published annually by the Chilton Company. The *Spectator* data are compiled from the annual statements that casualty insurance companies must file with the various state insurance departments. The figures designated "net losses" represent the amount of cash and medical benefits paid on workmen's compensation insurance policies during a calendar year. The total for the United States so reported is incomplete principally by the amounts paid by self-insurers and by certain state funds, chiefly those not required to file annual statements.

The *Spectator* data were, therefore, used as the basis for annual estimates of total workmen's compensation benefit payments. To the

TABLE

SELECTED SOCIAL INSURANCE AND RELATED PROGRAMS:

(Corrected to

Year and month	Total	Retirement, disability, and						
		Total	Monthly retirement and disability payments†				Monthly	
			Social Security Act‡	Railroad Retirement Act§	Civil Service Commission¶	Veterans' Administration**	Social Security Act††	Railroad Retirement Act§
	Amount (in thousands)							
Calendar year:								
1936	$461,760	$458,765	—	$683	$51,630	$299,001	—	$2
1937	505,143	499,532	—	40,001	53,694	299,660	—	444
1938	972,926	575,814	—	96,766	56,118	301,277	—	1,383
1939	1,046,006	608,095	—	107,282	58,331	307,512	—	1,451
1940	1,191,908	654,042	$21,075	114,166	62,019	317,851	$7,784	1,448
1941	1,090,104	726,631	55,141	119,913	64,933	320,561	25,454	1,559
1942	1,137,073	780,364	80,304	122,806	68,115	325,265	41,702	1,603
1943	929,415	838,046	97,257	125,795	72,961	331,350	57,763	1,704
1942								
December	79,566	67,333	7,338	10,402	5,858	27,493	4,082	137
1943								
January	80,392	67,307	7,464	10,302	5,913	27,310	4,171	135
February	79,209	67,763	7,623	10,364	5,941	27,293	4,308	138
March	80,534	68,778	7,781	10,386	5,968	27,416	4,492	140
April	77,486	69,230	7,871	10,444	5,985	27,410	4,615	140
May	76,797	69,454	7,976	10,386	6,022	27,449	4,735	139
June	75,849	69,288	8,004	10,432	6,067	27,456	4,770	143
July	76,114	69,702	8,193	10,447	6,087	27,820	4,824	143
August	75,630	69,511	8,262	10,565	6,095	27,307	4,912	148
September	76,497	70,475	8,358	10,602	6,180	27,393	5,056	142
October	75,924	71,376	8,471	10,609	6,195	27,716	5,174	146
November	76,408	71,912	8,566	10,615	6,228	28,204	5,284	142
December	79,019	73,250	8,686	10,643	6,280	28,574	5,422	148

* Data represent payments to individuals and exclude cost of administration. Payments under Social Security and Railroad Retirement Acts (including retroactive payments) and payments under Railroad Unemployment Insurance Act are amounts certified; payments under Civil Service Commission and Veterans' Administration are disbursements minus cancellations; State unemployment insurance payments are checks issued by state agencies. Totals are sums of unrounded figures, therefore may differ slightly from sums of rounded figures.

† Old-age retirement benefits under all acts, disability retirement benefits under Railroad Retirement and Civil Service Retirement Acts, and disability payments to veterans.

‡ Represents primary and wife's benefits and benefits to children of primary beneficiaries. Partly estimated.

§ Amounts certified, minus cancellations. Monthly payments to survivors include annuities to widows under joint and survivor elections and 12-month death-benefit annuities to widows and next of kin.

¶ Represents principally payments from civil-service retirement and disability fund but includes also payments from Canal Zone retirement and disability fund and Alaska Railroad retirement and disability fund administered by Civil Service Commission. Monthly retirement payments include accrued annuities to date of death paid to survivors. Data for calendar years 1936–39 estimated on basis of fiscal-year data.

III

PAYMENTS TO INDIVIDUALS, BY SPECIFIED PERIOD, 1936–43*

April 4, 1944)

survivor payments								
Survivor payments					Refunds to employees leaving Federal civil service¶	Unemployment insurance payments		
	Lump-sum							
Veterans' Administration‡‡	Social Security Act§§	Railroad Retirement Act§	Civil Service Commission¶	Veterans' Administration¶¶		Total	State unemployment compensation laws***	Railroad Unemployment Insurance Act†††
Amount (in thousands)								
$99,992	—	—	$4,062	$3,395	$2,864	$131	$131	—
96,370	$1,278	—	4,401	3,684	3,479	2,132	2,132	—
101,492	10,478	$291	4,604	3,405	3,326	393,786	393,786	—
109,192	13,896	1,926	4,952	3,553	2,846	435,065	429,298	$5,767
105,696	11,736	2,497	5,810	3,960	3,277	534,589	518,700	15,889
111,799	13,328	3,421	6,170	4,352	4,615	358,858	344,321	14,537
111,193	15,034	4,114	6,108	4,120	6,357	350,352	344,084	6,268
116,133	17,830	5,560	7,344	4,350	10,809	80,560	79,643	917
9,432	1,362	413	489	327	521	11,712	11,558	155
9,423	1,395	313	538	343	701	12,384	12,182	202
9,332	1,453	421	547	342	408	11,038	10,878	160
9,445	1,672	414	627	435	870	10,887	10,744	142
9,530	1,635	517	668	417	781	7,475	7,369	106
9,549	1,665	565	601	367	907	6,437	6,383	54
9,480	1,398	513	629	395	571	5,990	5,950	41
9,309	1,418	517	578	367	817	5,594	5,564	31
9,427	1,416	470	565	342	886	5,234	5,191	43
9,845	1,434	483	644	339	1,544	4,477	4,433	44
10,200	1,433	465	625	341	957	3,591	3,546	44
10,244	1,442	437	419	329	915	3,582	3,540	42
10,349	1,468	445	902	‡‡‡333	1,453	4,316	4,274	42

** Veterans' pensions and compensation payments.

†† Represents widow's, widow's current, parent's, and child's benefits. Partly estimated.

‡‡ Payments to widows, parents, and children of deceased veterans.

§§ Represents survivor payments with respect to deaths of covered workers under both the 1935 and 1939 acts, and, for the period January 1937–August 1939, payments to covered workers at age 65 totaling $9.9 million, which are not survivor payments.

¶¶ Payments for burial of deceased veterans.

*** Annual figures adjusted for voided benefit checks; monthly figures unadjusted.

††† 1941, 1942, and 1943 annual figures adjusted for underpayments and recoveries of overpayments; monthly figures unadjusted.

‡‡‡ Preliminary estimate.

Source: *Social Security Bulletin.*

amounts of "insurance losses paid" as reported in the *Spectator* were added the amounts paid by exclusive state funds and by those competitive state funds not included by *Spectator*. These data were obtained from published reports of the state workmen's compensation agencies or from unpublished data furnished by the agency. An estimate was then made of the amount of benefits paid in each state by self-insurers. The basis for these estimates was primarily data in the state reports and unpublished data supplied by state agencies in response to special requests.

Using these sources it was possible to build up an estimate of benefit payments under workmen's compensation laws on an annual basis. It was not possible from these sources, however, to obtain a basis for estimating payments on a monthly basis[2] nor to estimate the number of beneficiaries receiving payments. Work on this project is still under way and it is hoped that it will be possible to make such estimates in the future.

Estimates of benefit payments under state and local government retirement systems.—The problem of obtaining data relating to operations of these systems was similar to that for workmen's compensation but in some respects more difficult. This was due to the fact that not only do systems operate under state laws but also under many city and local ordinances. After reviewing the availability of reports from these systems, it was found that the smaller systems did not publish reports and while most of the larger systems did publish statistics on an annual basis, the lack of comparability between the reports and the absence of certain details made it necessary to seek other sources of information. It was decided, therefore, to ask the cooperation of the Division of State and Local Government of the Bureau of the Census in a mail canvass survey of the systems in operation. From the returns of this canvass, the Division of State and Local Government of the Census and the Division of Coordination Studies of the Board developed national estimates of benefit payments and beneficiaries for the fiscal year 1940–41. Using this over-all survey as a basis, it was possible to make estimates for other years from published reports and Census data.

The schedule used in the mail canvass contained items which permitted estimates to be made for total annual benefit payments, payments and beneficiaries in the last month of the fiscal year; it also covered employment and wages, and a few other items.[3] Thus for pur-

[2] The annual estimate made by the Social Security Board is used by the Department of Commerce in developing their income payment series. Monthly estimates based on this annual figure are made by the Department of Commerce by means of straight-line projections.

[3] See Bureau Report No. 12: *Scope of Protection Under State and Local Government Retirement Systems.*

poses of the integrated series, estimates for annual benefit payments are available but not payments for each month. Further work on this project will probably make it possible to estimate, by months, payments and number of beneficiaries receiving such payments. The Department of Commerce plans to substitute the annual estimates on benefit payments as derived from this survey for the figures it now carries in its income payment series. On the basis of this annual estimate it will make estimates of monthly payments.

For two other types of systems—Federal contributory and noncontributory retirement systems—data are available on an annual basis from the individual agencies. Monthly figures are not available[4] in reported form and these programs are therefore not included in Table III.

Table II presents total payments by program, while for the programs for which monthly data are available, as shown in Table III, payments are distributed into monthly and lump-sum payments under the different programs. A further breakdown of the data on an annual basis shows the following distribution of payments according to the type of risk for 1942, the latest date for which estimates are available.

Total*	$1,560 (million)
Retirement†	439
Disability	517
Survivor	254
Unemployment	350

* Differs from total in Table II because of omission of payments for medical care under workmen's compensation and due to use of the Board's estimates for state and local retirement systems instead of Commerce estimates. Approximately $33 million in refunds to employees leaving Government service are also excluded.

† Includes small amount of disability or survivor payments under Federal contributory or noncontributory systems other than Civil Service retirement system.

Distribution of annual payments under the old-age and survivors insurance program, the railroad retirement and unemployment insurance programs, the state workmen's compensation program, the workmen's compensation and veterans' program are also available by state.

Number of beneficiaries.—The number of beneficiaries receiving the benefit payments, shown in the monthly series on payments, has also been compiled for each program with the cooperation of the responsible agency (Table IV). The term beneficiary as used in connection with this series means a person entitled, on the basis of an insured worker's employment record, to a payment on account of old age, disability, unemployment, or death of the insured worker. Under the old-age and

[4] Estimates of monthly payments based on the annual figures are made by the Department of Commerce for inclusion in their income payment series.

TABLE IV

SELECTED SOCIAL INSURANCE AND RELATED PROGRAMS: INDIVIDUALS RECEIVING PAYMENTS, BY MONTHS, 1943

(In thousands; data corrected to April 4, 1944)

Month	Retirement, disability, and survivor beneficiaries											Employees receiving refunds upon leaving Federal civil service§§	Unemployment insurance beneficiaries	
	Monthly retirement and disability beneficiaries				Survivor beneficiaries									
					Monthly			Lump-sum‡‡						
	Social Security Act*	Railroad Retirement Act†	Civil Service Commission‡	Veterans' Administration§	Social Security Act¶	Railroad Retirement Act**	Veterans' Administration††	Social Security Act	Railroad Retirement Act	Civil Service Commission	Veterans' Administration		State unemployment compensation laws¶¶	Railroad Unemployment Insurance Act***
January	385.4	154.9	72.8	622.8	262.3	3.8	311.5	9.8	1.0	0.7	3.7	10.0	226.8	4.0
February	364.6	155.4	73.4	622.0	269.7	3.9	311.2	10.2	1.3	.7	3.7	9.3	208.6	3.5
March	369.9	155.4	73.7	621.0	279.2	3.9	311.9	11.9	1.2	.8	4.4	14.8	181.5	2.6
April	375.1	155.6	74.0	620.8	288.2	3.9	312.2	11.8	1.4	1.0	4.1	13.1	131.2	1.9
May	380.6	155.6	74.4	621.9	297.2	3.9	313.4	11.9	1.6	.9	3.8	13.0	119.5	1.0
June	383.9	156.0	74.8	623.0	302.9	4.0	314.8	10.0	1.4	.9	3.8	12.2	100.3	.7
July	390.7	156.3	74.7	624.8	307.0	4.0	313.1	10.2	1.4	.9	3.7	20.9	90.6	.5
August	393.9	157.1	75.1	627.0	312.4	4.1	313.9	10.2	1.3	.8	3.2	22.3	88.8	.7
September	397.3	157.7	75.5	629.1	321.5	4.1	315.6	10.2	1.3	1.0	3.5	27.5	74.5	.7
October	401.3	158.1	76.0	633.7	329.5	4.1	318.4	10.1	1.2	1.3	3.4	17.3	60.7	.7
November	405.9	158.6	76.6	640.1	336.9	4.1	320.5	10.2	1.2	.8	3.4	18.4	56.4	.7
December	411.4	159.0	76.8	648.6	344.6	4.1	322.7	10.5	1.2	1.4	3.3	25.6	64.4	.7

* Primary beneficiaries and their wives and children for whom benefits were certified.

† Annuitants and pensioners on roll as of 20th of month; includes disability annuitants.

‡ See Table III, footnote 5. Includes persons receiving survivor benefits under joint and survivor elections. Figures not adjusted for suspension of annuities of persons reemployed under National Defense Acts of June 28, 1940, and Jan. 24, 1942.

§ Veterans receiving pensions and compensations.

¶ Widows, parents, and children for whom benefits were certified.

** Widows receiving survivor benefits under joint and survivor elections and next of kin receiving death-benefit annuities for 12 months; number on roll as of 20th of month. Widows receiving both survivor and death-benefit annuities are counted twice, but 2 or more individuals sharing 1 death-benefit annuity are counted as 1.

†† Widows, parents, and children of deceased veterans on whose account payments were made during month.

‡‡ For Social Security Act, deceased wage earners whose survivors received payments under either the 1935 or 1939 act; for Railroad Retirement Act, deceased wage earners whose survivors received payments certified in month ended on 20th calendar day; for Civil Service Commission, employees who died before retirement age and annuitants with unexpended balances whose survivors received payments; for Veterans' Administration, survivors or other persons entitled to reimbursement for expenditures in connection with burial of deceased veterans.

§§ See Table III, footnote 5 for programs covered.

¶¶ Represents average weekly number of benefit recipients.

*** Represents average number of persons receiving benefits for unemployment in a 14-day registration period.

Source: *Social Security Bulletin.*

survivor program, several beneficiaries can be entitled to a monthly retirement benefit on the basis of one worker's wage record; thus if at time of retirement, the wife of the insured worker is also 65 or over she is entitled to a benefit equal to one-half of the worker's benefit as are all children under 16 or aged 16–18 if in school, subject to the limitation that the total benefit shall not exceed twice the primary benefit.

For the other programs making monthly retirement or disability payments as shown in the Table the benefit is made to the insured person only and is not increased for dependents. In the case of monthly payments to survivors both the OASI and veterans' programs make payments to widows and children on the basis of one employment or service record and each entitled member of the family is recorded as a beneficiary. Under the railroad retirement and civil service programs monthly survivors benefits are paid only to survivors of annuitants who have elected a reduced annuity during their own lifetime, and there is ordinarily only one beneficiary for an insured worker. Under the unemployment insurance programs the beneficiaries represent only the unemployed workers inasmuch as benefits are not adjusted for the number of dependents.[5]

It should be noted that the number of beneficiaries under the different programs should not be totalled in order to obtain the number of individuals receiving benefits inasmuch as the same beneficiary may be receiving payments under two different programs. No estimates have yet been made as to the extent of this duplication. It should be noted also that the number of different individuals receiving weekly unemployment benefits during a month will be larger than the average weekly number of beneficiaries shown in Table IV or than the number in any one week during the month.

In some cases the number of beneficiaries represents the number who were certified for payment during the month, in other cases the number on the rolls as of a certain day of the month, and for the unemployment insurance programs the average number receiving payments in a period during the month. While the unit of count varies thus among the programs, the data are on as comparable a basis as is possible. Except as concepts necessarily differ for weekly and monthly benefits, differences are not of such magnitude as to affect to any serious degree comparability of the data.

The number of beneficiaries receiving payments under the state and local government retirement systems is available only for the last

[5] Except in the District of Columbia where the beneficiaries reported represent workers only.

month of each fiscal year; for the workmen's compensation program and the Federal retirement program, other than under the Civil-service retirement system, no data on the number of beneficiaries are available.

The classification of beneficiaries follows that for payments, and the total number of beneficiaries under each program can be obtained as well as the number receiving the same type of payment under different programs.

Estimates of the number of families receiving monthly benefit payments based on the beneficiary data are also available. From OASI beneficiary tabulations on family size, it is possible to reduce the number of persons receiving benefits under this program to a family basis. The number of beneficiaries receiving monthly retirement or disability payments under the railroad retirement and civil-service retirement programs represents approximately the number of families receiving benefits since these programs do not provide supplemental benefits for wives and children of retired workers. Statistics are available from the Veterans' Administration which give the number of families receiving monthly survivor payments while the number receiving monthly compensation payments represents the number of veterans only and therefore represents a like number of families. Beneficiaries of unemployment compensation payment also represent the number of family units except insofar as there may be occasional families with more than one unemployed member drawing benefits. For December 1943 the number of families represented by the 756,000 monthly beneficiaries under the OASI program is estimated at 472,000; under the railroad and civil-service retirement programs the number of families receiving monthly payments was approximately 239,900; the 971,300 monthly beneficiaries of the Veterans' Administration represented about 892,800 families.

From the data presented in the foregoing tables it is possible to obtain a measure of the number of individuals receiving payments under social insurance and related programs and the amount of such payments. While such information is valuable to students of social and economic problems, it is, of course, subject to several limitations in evaluating the extent of social insurance protection. Such factors as differing benefit levels, eligibility requirements, coverage provisions and other items provide useful and necessary criteria in any measurement of social security protection. However, the over-all data on payments and beneficiaries form a basic part of the total picture necessary in an evaluation of social security needs in the country.

USE OF THE SURVIVAL RATE METHOD IN MEASURING NET MIGRATION*

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The use of the survival rate method for measuring net migration during intercensal periods has been developed in the United States by Hart (1), Baker (2), Hamilton (3) and (4), Lively and Taeuber (8) and Lorimer (7).

Although the method is quite simple and has been widely used, some further refinements and applications have been made since the publication of the United States census for 1940. Therefore, the purposes of this paper are:

1. To demonstrate that in measuring net migration during recent intercensal periods survival rates derived from the age distributions of the federal census are superior to survival rates derived from life tables.
2. To show how survival rates based on state and national life tables may be used in adjusting federal census survival rates for use on a state basis.
3. To demonstrate two reliable methods of deriving survival rates for use in measuring net migration on a county basis.
4. To draw attention to the method of measuring the rate of net migration and of calculating the amount of migration among people who die during an intercensal period.
5. To explain a method for measuring the relation between net migration and population pressure.

SUPERIORITY OF CENSUS SURVIVAL RATES FOR CERTAIN PURPOSES

A survival rate is the complement of a mortality rate. If the mortality rate is .012, then the survival rate is .988. Survival rates for most purposes may be calculated from the L_x column of a life table showing the "stationary population in year of age X to $X+1$."

The life table survival rate is simply the ratio of the stationary population in a given age interval to the population in a lower (younger) age interval. The rate thus calculated expresses the proportion of the

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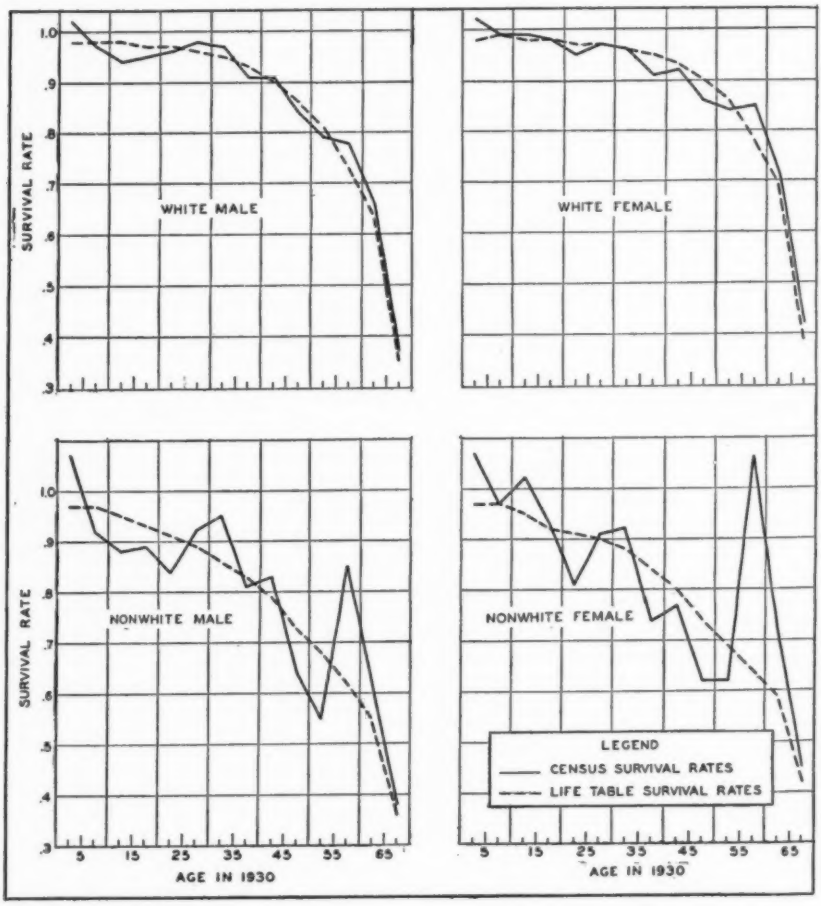
lower age group which will probably survive until the higher age level is reached.

The advantage of using a life table is that rates for any age group and for any time interval may be easily calculated. Thus, life table survival rates have been used in measuring net migration from farms during the periods 1930–35 and 1935–40 (8). Life table survival rates also have many other uses.

Census survival rates are calculated directly from the age distribution tables of the United States censuses, on the assumption that migra-

CHART I

SURVIVAL RATES BY SEX AND COLOR COMPARING CENSUS AND LIFE TABLE SOURCES



tion to or from the United States has been negligible during the period involved.

A census survival rate, for a ten-year period, is simply the ratio of

TABLE I

SURVIVAL RATES BY AGE, SEX AND COLOR, 1930–1940, FOR POPULATION OF THE UNITED STATES AS CALCULATED FROM LIFE TABLES AND FROM CENSUS*

Age groups		White male		White female		Nonwhite male		Nonwhite female	
1930	1940	LTR†	CR†	LTR	CR	LTR	CR	LTR	CR
0–4	10–14	.975	1.019	.980	1.021	.968	1.069	.972	1.068
5–9	15–19	.984	.973	.988	.990	.970	.923	.970	.969
10–14	20–24	.979	.944	.984	.989	.951	.884	.945	1.017
15–19	25–29	.963	.952	.977	.979	.928	.892	.923	.934
20–24	30–34	.978	.963	.973	.952	.906	.841	.910	.806
25–29	35–39	.961	.983	.968	.971	.886	.916	.896	.912
30–34	40–44	.950	.970	.960	.962	.863	.951	.875	.920
35–39	45–49	.931	.909	.948	.910	.829	.806	.844	.747
40–44	50–54	.903	.914	.929	.923	.785	.826	.801	.766
45–49	55–59	.862	.838	.900	.863	.730	.641	.743	.619
50–54	60–64	.805	.787	.855	.836	.675	.558	.685	.624
55–59	65–69	.728	.775	.788	.847	.619	.853	.638	1.059
60–64	70–74	.625	.657	.690	.717	.547	.618	.586	.721
65–up	75–up	.355	.372	.393	.422	.364	.380	.415	.450

* The Life Tables used in these calculations were constructed by the authors using Metropolitan Life Insurance Company data as well as United States Vital Statistics Reports.

† LTR indicates *life table* rates, and CR indicates *Census* rates.

TABLE II

RATES OF NET MIGRATION FROM FARMS OF THE UNITED STATES DURING DECADE 1930–40 BY AGE, SEX AND COLOR, AS CALCULATED BY LIFE TABLE RATES (LTR) AND CENSUS RATES (CR)*

Age	White male		White female		Nonwhite male		Nonwhite female	
Groups†	LTR	CR	LTR	CR	LTR	CR	LTR	CR
5–9	1.4	1.9	− 2.2	− 1.4	− 1.8	− 6.7	− 6.7	−10.8
10–14	− 3.5	− 2.4	−12.8	−12.9	−15.7	−11.4	−18.1	−18.1
15–19	−25.6	−22.8	−36.7	−37.1	−32.6	−27.5	−31.2	−36.1
20–24	−36.9	−35.5	−35.8	−36.0	−42.0	−39.7	−41.4	−42.0
25–29	−23.0	−22.6	−14.6	−13.0	−31.7	−26.4	−36.9	−28.8
30–34	1.0	1.0	3.6	3.2	− 4.9	− 8.0	−10.3	−11.9
35–39	7.7	5.4	2.6	2.4	7.6	− 2.4	− 2.7	− 7.5
40–44	4.7	7.2	− 3.0	1.1	0.3	3.2	−17.2	− 6.4
45–49	8.2	6.8	− 2.0	− 1.4	16.9	11.0	−10.6	− 6.5
50–54	3.6	6.5	− 7.1	− 3.1	− 7.8	5.1	−26.0	−11.1
55–59	.8	3.2	− 9.4	− 7.4	−21.7	− 5.4	−19.2	−11.3
60–64	8.2	1.6	− 4.3	−11.0	30.7	−15.9	42.0	−14.5
65–69	1.7	− 3.2	−10.1	−13.4	−11.6	−12.8	4.2	−15.2
70–over	− 2.8	− 7.3	− 2.7	− 9.4	− 8.4	−12.3	− 1.3	− 8.9

* Life Tables used in these calculations were constructed by the authors, using Metrpolitan Life Insurance Company data and U. S. Census Vital Statistics Reports. The CR rates relate to total population and not to farm population.

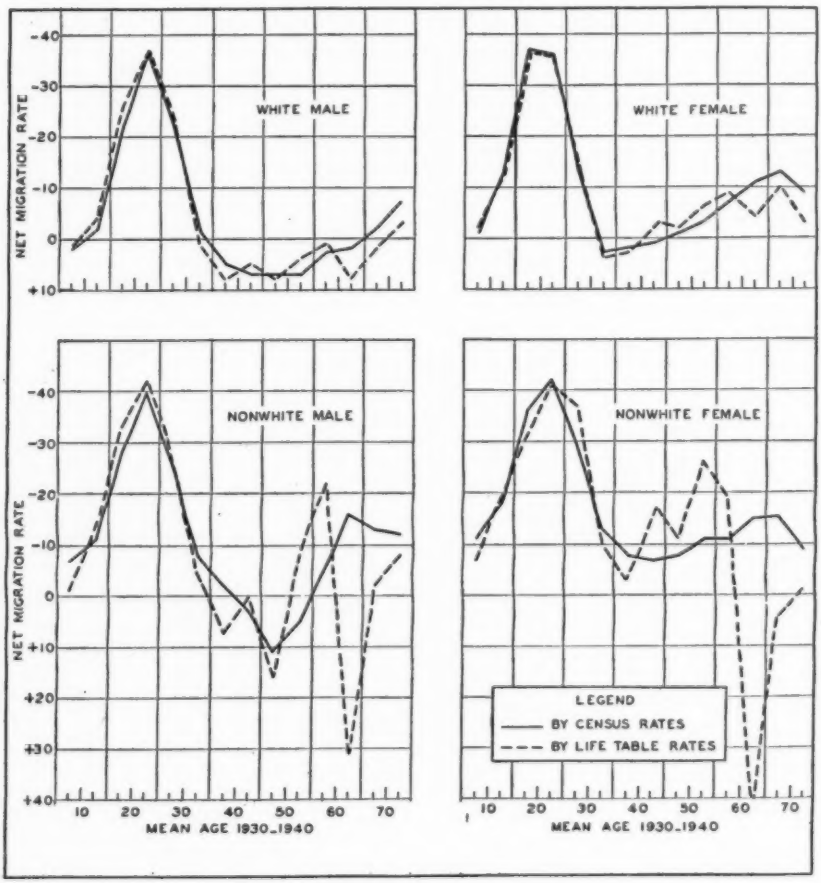
† As of middle of decade. Midpoints used on charts.

population of a given age at the end of the period to the population ten years younger at the beginning of the period. A twenty year survival rate might also be calculated but migration is rarely a negligible factor over such a long period. Obviously, census survival rates are more restricted in usefulness than life table survival rates.

However, census survival rates have one distinct advantage, that is, *they serve not only as survival rates but also as correction factors for errors in reporting ages to the census.* This point has been treated elsewhere, (3) and (4). Further confirmation is given in this paper. Chart I and Table I show a comparison between *life table* and *census* survival rates.

CHART II

NET MIGRATION RATES BY SEX AND COLOR, COMPARING RESULTS OBTAINED BY APPLYING CENSUS AND LIFE TABLE RATES



The assumption is that the age curve of net migration should be a relatively smooth one. But as shown in Chart II based on Table II, the age curve of net migration from the farms of the United States between 1930 and 1940 is quite irregular when compared with the corresponding curve based on census rates. If the assumption is granted (and it is certainly reasonable), these data are proof of the superiority of census rates.

In calculating census survival rates for the decade 1920–30, the age distributions of native white and of Negro population, by sex, should be used in order to eliminate the bias due to net migration to America of approximately 3,000,000 people during that time (12).

Some error, however, enters in, because an unknown number of foreign born whites, so reported in 1920, report themselves as native whites in 1930. This tends to make the census survival rates for native whites somewhat too high (4, p. 62). This error is probably not as great as it might be were the census survival rates based upon the total population. A migration of approximately 3,000,000 net to the United States between 1920 and 1930, was enough to cause considerable bias in census survival rates based upon total population.

Net migration to or from the United States between 1930 and 1940 was relatively small—being only 47,000 out movement (13). Therefore, during this period, the bias in census survival rates, based upon total population is much less than it would be if they were based upon the native born population. Henderson (14, pp. 41–42) estimates that over 100,000 persons classified as foreign born white in 1930 were classified as native white in 1940.

ADJUSTING SURVIVAL RATES FOR REGIONAL MORTALITY DIFFERENCES

Census survival rates calculated on a national basis may and should be adjusted for mortality differences in the various states or regions for which estimates of survivors and migration are to be made. Life tables and life table survival rates for the Nation and for the states and regions serve as a basis for calculating the necessary correction or adjustment factors.[1]

The correction factors are simply the differences between the life table survival rates of the United States and those of any given state or region. These correction factors are either added to or subtracted from, depending on the signs, the federal census survival rates. The re-

[1] Life tables for the United States and for major regions in the United States are published by the Census Bureau. It is not difficult to construct abbreviated life tables for the various states.

sult is a state or regional survival rate which has the advantages of being sensitive to errors in age reporting on a national basis as well as to mortality factors in the states and regions.

Census survival rates cannot, of course, be obtained by residence groups; and the use of over-all rates for measuring rural-farm migration assumes that mortality rates among rural-farm people and the irregularities in age reporting are not significantly different from those in the total population.

Adjustments in census survival rates because of differences in mortality on farms and in the Nation as a whole would be in order if adequate mortality data were available. However, mortality differences between country and city are not great enough to make much difference in the final results.

In recent years urban and rural mortality rates have come closer together—urban rates still being somewhat higher.[2] The regional differences discussed above are considered much more important than the rural-urban differences.

DERIVATION OF ABBREVIATED SURIVIVAL RATES FOR USE ON A COUNTY BASIS

Survival rates for use on a state and national level are calculated for each five year age group by sex and color. On a county level, however, because of the limited tabulations available and because of the amount of computation involved, it is necessary and desirable to devise abbreviated rates: (1) by age only or (2) by sex and color only. Census tables do show age, sex, and color data for total county population but not for the urban, rural-nonfarm, and rural-farm populations of counties. In these major residential groups census tables show county population by age only in 1930 and by age and sex only in 1940. However, in both censuses, the county populations are tabled by sex and color for the urban, rural-nonfarm, and rural-farm groups.

Survival rates by age only. Using state sex ratios by residence as weights, male and female rates are added together, producing a state table of survival rates by color, age, and residence. Then using white and nonwhite ratios in counties as weights, sets of survival rates by age were derived for counties of varying proportions of white and nonwhite persons. Sets of such rates were prepared for counties having, on the average between 1930 and 1940, 0–4 per cent, 5–9 per cent, etc. of nonwhite persons. Thus for each county it was possible to estimate expected populations, expected increase, and net migration by age.

[2] See Dublin, Louis I., and Lotka, Alfred J., *Length of Life*, New York: Ronald Press, 1936, pp. 90–101. Particularly, Table 16, p. 91.

It is hardly necessary to point out that these county survival rates ignore not only varying sex ratios but also varying mortality rates by counties. The errors thus introduced are relatively small in comparison with the high rates of migration from farms in the various counties. Compare with reference (8), Lively and Taeuber, pp. 164–165.

Survival rates by color, sex and residence. By using age group proportions in each state residence group as weights, survival rates by age, in each sex and color group are combined to form survival rates by residence, sex, color. Age is sacrificed but a residence differential is gained. Application of these rates to the 1930 county populations yields estimates of expected population, expected increase, and net migration by color, sex, and residence but not by age.

Obviously, mortality differences by counties are ignored and it is assumed that age distributions by residence in the counties are not greatly different from the corresponding age distributions in the state. Compare with reference (8), Lively and Taeuber, pp. 164–165.

Validity of county survival rates. As a basis for testing the validity of the two procedures described above, detailed estimates of net migration by color, sex, and age in the total population of six widely scattered North Carolina counties were made. These results were then correlated with the results obtained by applying the abbreviated survival rates to urban, rural-nonfarm, and rural-farm populations of the same six counties. Adding the residential estimates together by age made possible a correlation on an age basis; and then by adding the residential estimates together by sex and color, a correlation by sex and color in the six counties was made possible. The coefficients of correlation were .99 and .93, respectively.[3]

Another test of validity was made by obtaining the correlation coefficient between the net migration obtained by (1) the weighted age survival rates and (2) by the sex, color, residence survival rates. The coefficient of correlation was found to be .99. In this correlation we made a test of the hypothesis that this high correlation might have been due to the size of the county population. The correlation coefficients between farm population per county and net migration as measured by the two methods described above were .73 and .72, respectively. Holding population constant by partial correlation gives a partial coefficient of .98.

Obviously, if a total net migration figure for each county is all that is wanted, then it makes little difference which method is used. How-

[3] These correlations were so high that it was hardly considered necessary to eliminate the factor of "size of population" in the various sex and color groups. However, if anyone is skeptical see next paragraph for a similar test. The standard errors of these coefficients were negligible.

ever, both methods are of value within themselves and have high validity not only for totals but also for sex, color, and age groups within counties.

DEFINING THE RATE OF MIGRATION

The ratio of net migration to the expected population is the best measure of the rate of migration during a decade. In a statistical sense it is best because its base or denominator includes all living persons who could have migrated and the numerator represents the number of persons (net) who did migrate.

What of people who have died? How many of them migrated during the census interval? The only answer this method gives to that question is based on the assumption that while they were alive, they migrated at the same rate as other living persons.

This assumption may, of course, be wrong because morbidity preceding death might affect migration in no small degree. Yet, if the assumption is accepted, then the number of persons dying may be determined by subtracting the number of expected survivors from the persons alive at the beginning of the decade. The estimated number of people who migrated before they died is simply the product of the net migration rate and one-half of the number of estimated deaths. It can only be assumed that the deaths were distributed more or less evenly over the decade and that the average time alive during the decade was five years.

The utility of calculating the number of deceased migrants is questionable, because after all the rate of migration is the more important figure; and it is not at all affected by the calculation of deceased migrants. However, if it is desired to compare the results obtained by this method with results obtained by the annual surveys of the U. S. Bureau of Agricultural Economics then it would be necessary to calculate the deceased migrants (8, pp. 163–164).

MEASURING THE RELATION OF POPULATION PRESSURE TO NET MIGRATION FROM FARMS

Definition of population pressure. A statistical measure of population pressure is the extent, absolute or relative, to which expected population at the end of a decade exceeds or replaces the population of the corresponding age at the beginning of the decade. This definition holds true for all age groups as well as for the total population.

Actually it is the same thing as natural increase or replacement. Replacement rates by age are, in other words, measures of population pressure by age. Replacement rates for a total population or for spe-

cific age groups may be obtained from the same basic material used in measuring net migration.

Illustration. In 1930 there were, according to the United States Census, 786,677 white male persons 25–29 years of age on the farms of the United States. From a younger age group 15–19, coming on to replace these people in 1940 were 1,442,972 survivors, or an excess of 656,295. The replacement rate for this age group was 183.4 per cent. Net migration from farms in this same age group during the decade 1930–1940 was found to be 512,905 or 65.2 per cent of the 1930 population 25–29 years of age.[4]

Correlation analysis. An inspection of similar data for other age groups leads to the conclusion that there is a high correlation between expected population increase and net migration. (*Vide* 3, p. 40.)

The next logical step is to correlate expected population changes with net migration by counties—both for specific age groups and for the total population. This procedure is being followed with the North Carolina data and the results will be described in detail in another article. However, the analysis has been carried far enough to reveal some highly significant and useful relationships.

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THE RISING LIQUIDITY OF MANUFACTURING COMPANIES AND ITS IMPLICATIONS FOR FINANCING POSTWAR CONVERSION

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Among large manufacturing companies, 1941 was a year of declining cash balances, while 1942 and 1943 have been periods of increasing cash. This shift raises a question whether the present trend can be counted on to continue and, if so, how the liquid position of manufacturing companies at the end of the war will compare with prospective needs for funds in reconversion.

The range of popular opinion on this question is great. On the one extreme stand those who feel that corporations are profiting hugely from the war and who, loosely associating profits with liquidity, infer that the 33 billion dollars of quick liquid assets in the hands of all corporations represent war profits that can be distributed to stockholders after the war.[1] At the other extreme stand the businessmen who reinvest their retained earnings in plant and who see in the consequently declining "current ratio" only an impending disaster. Each time one of these men encounters a comment on the way bank deposits of business firms are looking up, he is sure to cite a company—which he regards as typical—that does not share this deposit experience, or which is anticipating heavy reconversion costs.

In this confusion of facts and their interpretation, there is evidently needed some analysis of recent trends in the financial experience of more than a few companies, together with a projection of these trends forward to the time when termination of war contracts will be the predominant condition. True, the adjustments to be met at that time cannot yet be fully foreseen. Conceptually, however, we can divide these adjustments into two classes: foreseeable adjustments in current assets and liabilities, and other adjustments which are as yet difficult to gauge, such as dismissal wage payments, restoration of industrial capacity for civilian products, outlays for reestablishing market outlets, etc. By estimating roughly the magnitude of the foreseeable adjustments, we can begin to make progress toward visualizing the over-all financing needs of industry in the reconversion period.

* The figures presented in this article were compiled at the Board of Governors, but the views expressed here are those of the author alone and are not to be construed as reflecting the opinion of the Board.

[1] See for example "War Profits and the Press" in *The Nation* for October 9, 1943.

It is with this objective in mind that the present article explores the recent financial experience of large manufacturing companies. In an effort to meet the difficulty that every large company is to some extent a special (and therefore unrepresentative) case, statements for about 500 companies have been tabulated and analyzed for the years 1940–42 and the results have been chained to tabulations prepared by the Securities and Exchange Commission for 892 companies for the years 1935–39.[2] Sales and assets of the 500 companies represent well over half of all manufacturing and mining, and the additional companies included in the SEC tabulation represent another 5 per cent.[3] While these large companies are disproportionately representative of war industries, this bias is probably not undesirable in analyzing the special problem of reconversion needs.[4]

Analysis of recent sources and uses of funds for this group of corporations indicates that several changes are in prospect in the relative importance of component items. During the past two years Government funds have been a major factor contributing to corporate liquidity. Advances on contracts have been large, and some private financing of inventories has been obviated by means of progress payments. In addition, large amounts of short-term funds have been made available, as increases in income tax liability have not had to be paid until a year after the assessed income has accrued. In the latter half of 1943 and in 1944, these sources of corporate liquidity are likely to be less large, but the effect of their decline on liquidity is being offset by lower levels of new investment in plant and working capital. The net result appears to be a continued increase in liquidity, with increasing amounts available for investment in Government securities.

If we assume, for the sake of simplicity, that termination of war contracts will be a prevalent condition by the end of 1944 and try to envisage the adjustments in financial position which this will entail, two significance inferences stand out very sharply. One is that the need of industrial corporations in the aggregate for outside financing will de-

[2] See *Statistics of American Listed Corporations, Part 2*, 1941, pp. 70–71. For the purpose of this analysis, the SEC data have been slightly modified, first by some additions and omissions in the list of companies included, and second to correct apparent inconsistencies in tabulating certain items, especially surplus adjustments.

[3] In 1939 the entire 892 companies held about 58 per cent of the plant and equipment and about 68 per cent of the cash of all manufacturing and mining companies. Superficial comparison of the sales figures for our sample with the totals reported to the Bureau of Internal Revenue suggests a somewhat lower coverage, about 43 per cent. However, allowance should be made here for the fact that many of the larger companies reported to the Bureau of Internal Reveue on an individual-company basis, while providing consolidated reports to the SEC and to the public. Thus the published statements which were used for our analysis wash out an appreciable amount of interaffiliate sales (as well as other income items).

[4] To obtain a more balanced over-all picture, these data are now in process of being analyzed by individual industries and by different size groups.

pend to a major degree on what provisions are available for prompt settlement of the bulk of Government obligations under war contracts. If 75 per cent or more of these obligations can be paid almost at once, many companies will be able to scale down their current liabilities and to build up inventories and receivables for civilian operations, with little or no new financing from banks or the public security markets.[5] If, on the other hand, no such provision for immediate Government disbursement is made, the need for reconversion financing by most companies will be very large, approaching in extreme cases the sum of wartime current liabilities plus new inventories and receivables required for civilian operations.[6]

A second inference of importance from our analysis is that most of the funds to be disbursed nominally by private corporations for conversion purposes will actually have to come from Federal agencies. This follows partly from the fact that wartime inventories and receivables are carried largely for Government account, and also from the fact that a major portion of the present increase in liquidity is being placed in Government securities rather than in cash. This means that, without necessarily alluding to any public works program, we may say the problem of financing industrial reconversion is a problem of Government financing, to a much greater extent than is generally realized.

These broad conclusions, however descriptive of manufacturing companies in the aggregate, do not of course apply to all individual companies, nor even perhaps to the majority of companies. This limitation arises from the fact that prospective deficiencies of funds for some companies in the group tend to be concealed by being averaged in with the surplus liquidity of other companies.

Recent liquidity due mainly to two factors.—In comparison with normal peacetime operations, recent financial developments in manufacturing industries have been dominated by two wartime conditions: private requirements for capital expenditures have been greatly lessened by Government action in providing special plants and by restrictions on private expansion, while sources of short-term funds have been augmented by direct and indirect financing with Government funds.

Nearly half the manufacturing facilities constructed with Govern-

[5] It should be observed that this statement refers only to financing of reconversion costs. Doubtless many companies will find it desirable to begin long-range expansion programs and to initiate the financing of such programs during the reconversion period. The present analysis is not intended to throw light on the amount of such financing.

[6] In reaching this conclusion, allowance has been made for the fact that over half of all bank loans outstanding for war production have been made under the provisions of Regulation V of the Federal Reserve System, and accordingly will not need to be retired in advance of settlement of war contracts.

ment funds is being or will be leased during the war to private companies and has thereby obviated private expenditures.[7] Probably an equally important factor holding down the volume of private expenditures has been restrictions on availability of materials, together with pressure to use existing facilities more intensively. Besides the effect in reducing capital expenditures, this development has helped to reduce overhead costs, increase profit margins, and thereby contribute further to corporate liquidity. At the same time expenditures for renewal and replacement of old equipment have been held down to a minimum consistent with over-all production goals.

Illustrative of the comparative limitation of capital expenditures during the war period are data compiled from financial statements representing about 890 large manufacturing companies for the years 1935 through 1942. Preceding the period of war expansion, sales of these companies increased from 19.9 billion dollars in 1935 to 25.6 billion in 1939, a gain of 5.7 billion; this gain was accompanied and facilitated by gross additions to plant capacity totalling 5.5 billion dollars for the four years. In the following three years, however, sales rose further to 50.6 billion for 1942, an expansion of 25 billion from the 1939 level, while private capital expenditures totalled only 5.2 billion.

These figures are shown in Table I, which summarizes major sources and uses of funds for these corporations during the two periods.[8] It will be seen from the table that the uses of funds for working capital purposes, i.e., for expanding customer credit and inventories, increased more nearly proportionate to the dollar increases in sales (mentioned in the preceding paragraph) than did capital expenditures.

The second major factor contributing to corporate liquidity during the war period has been the increased availability of Government funds. Direct advances on contracts for the manufacturing companies represented in the table have amounted to 2.7 billion dollars. In addition, the typical deferral of payment for income tax liability for a 12 month period has provided these companies with short-term funds amounting to nearly 4 billion dollars over the three-year period. A third form in which Government funds have been made available is progress payments on war contracts. In contrast to the customary peacetime

[7] While most of the remainder is managed by private companies on a fee basis, the output of these plants is not included in the sales data on corporate financial statements. They are therefore assumed to be outside the scope of the present analysis.

[8] These figures represent the *net* inflow and outflow of funds from various sources during the indicated periods. As regards current operations, there is omitted from both halves of the table an amount equal to cash disbursements for current production expenses.

For those interested in relating these changes to the absolute level of the corresponding assets and liabilities, a partial balance sheet is provided in Table IV covering the years 1935–42 with projections for 1943 and 1944.

TABLE I

MAJOR SOURCES AND USES OF FUNDS FOR ABOUT 890 MANUFACTURING COMPANIES DECEMBER 31, 1935–1939 AND DECEMBER 31, 1939–1942*

(in billions of dollars)

	4 years 1935–39	3 years 1939–42
Uses of funds		
Increase in receivables	0.6	3.4
Increase in inventories	1.2	3.8
Capital expenditures	5.5	5.2
	7.3	12.4
Sources of funds		
Increase in:		
Government advances	0.1	2.7
Accrued income tax liability	0.2	3.8
Trade accounts and other current liabilities†	0.5	1.5
Security issues and bank loans‡	1.0	0.8
Sales revenue earmarked for depreciation and other reserves	4.3	5.1
Net profit retained after dividends	2.0	2.8
	8.1	16.7
Balance, change in liquidity		
Increase in cash and temporary investments§	0.8	4.3

* For years 1935–1939, statements for about 890 companies are based on data published by Securities and Exchange Commission in *Statistics of American Listed Corporations*. For later years, data are based on reports for about 500 companies adjusted to a comparable basis. (Reports for 1942 are incomplete and estimates are therefore subject to revision.) The balance sheet data from which this table is computed are shown in Table IV.

† Not including bank loans.

‡ Bank loans, as represented by notes payable, are included with outstanding securities because many companies classify notes and bonds on the basis of maturity rather than kind of creditor. Funds obtained through security issues are adjusted to exclude amounts passed on to nonconsolidated affiliates.

§ While purchase of temporary investments is really a *use* of funds, the fact that they may represent surplus liquidity makes it desirable to classify them with cash as a residual item. For a breakdown between cash and temporary investments in the years 1940–1942, see Table II.

procedure of not billing a customer until his order is completed and shipped, work on cost-plus-fixed-fee contracts has been billed at intermediate stages, thus cutting down on the amount of inventories that need to be financed by the manufacturer. This practice is reflected in Table I by the fact that inventory expansion during the war period has been smaller, relative to the dollar increase in sales, than it was in the prewar period, while the increase in receivables has been somewhat larger.

In these various ways, Government funds have provided about half the increase needed to finance wartime operations of these manufacturing companies. Most of the remainder has been readily provided through the usual internal sources, i.e., revenues set aside for depreciation of plant and equipment and for other costs not yet assessable

("contingency reserves"), and from net income retained after payment of dividends. The net result of these developments has been an increased inflow of funds somewhat exceeding the increased use of funds, so that cash and temporary investments were in 1942 about 100 per cent above 1939 levels. This is about the same percentage increase as shown by sales of these companies.[9]

The growth of corporate liquidity from these sources explains largely why manufacturing companies in the aggregate have made only nominal demands on the security markets and on commercial banks for financing during the war. This has contrasted sharply with the normal financing that would be expected in a peacetime boom. While peacetime tax rates might have left an additional 5 billion dollars or more of income to be retained by the present group of manufacturing companies, their capital expenditures might have been 8 to 10 billion higher. In such a hypothetical situation, and with no Government advances or progress payments, the net new funds required by these companies from banks and security markets during a three-year period might easily have come to 8 billion or more, in place of the 0.8 billion shown in the table.

Appraisal of liquidity in terms of working requirements.—Among casual observers, there appears to be a common tendency to regard the increase in liquidity as an accumulation of "excess" cash. Doubtless there are many instances where this is unequivocally true, especially in the field of trade where inventories have been sold off and cannot be replaced. For large manufacturing companies in general, however, it seems debatable whether the increase in corporate liquidity through 1942 was much larger than the increase required for working capital purposes. The cash component, which may be viewed as the fund required to assure regular payment of pay rolls and other current disbursements in the intervals between receipts from sales, was as low relative to current sales activity at the end of 1942 as at any other year-end[10] back to 1935. As for temporary investments, if we can assume that this type of asset is used mainly as a reserve for accrued income tax liability, it is interesting to observe that at the end of 1942, temporary investments amounted to 83 per cent of the year's income tax liability. This percentage was lower than for any other recent year except 1941.[11]

[9] See Table IV.

[10] This statement is based on a comparison of cash balances at the end of December with estimated cash sales for the month of December. In relation to *annual* sales, cash balances at the end of 1937 appeared to be lower than at the end of 1942. However, in December 1937, manufacturing activity was 24 per cent below the annual average, while in 1942, December activity was 11 per cent *above* the annual average.

[11] In an unpublished manuscript, "Corporate Cash Balances in Peace and War," Professor Friedrich

Appraisal of manufacturing liquidity during remainder of war period. —Among the important implications of increasing corporate liquidity, is its relation to the financial adjustments that may need to be made after the war. In this connection, three questions come to mind on which our analysis of corporate statements may throw some light:

(1) Since the extension of Government funds has been a major factor in recent corporate liquidity, will the tapering off of these funds during the rest of the war mean a decline in liquidity?

(2) How will corporate liquid assets at the end of the war compare with the amounts needed to discharge current obligations and to make other expenditures that may be needed in converting operations back to civilian products?

(3) What are the prospects that banks and security markets will be called on to provide additional funds?

To provide a basis for judging the continuance of corporate liquidity in manufacturing industries, the major factors at work are shown in Table II for individual war years, together with rough estimates of their possible magnitude in 1943 and 1944, assuming continuation of full scale war activity. This table brings out the fact that in 1941, the peak year for private capital expenditures and for inventory expansion, cash balances declined below the previous year's level, and the growth in temporary investments covered only half the increase in income tax liability. In 1942, lower levels of capital expenditure and inventory expansion, together with larger increases in Government advances, facilitated substantial additions to cash and temporary investments.

For 1943 and 1944, private capital expenditures are estimated to decline further, and the tapering off of further increase in manufacturing activity will mean less absorption of funds in customer credit and inventories also. These decreases in use of funds will more or less offset the reduction in funds coming from Government sources—that is from Government advances and from deferred income-tax liability. Funds provided internally, however, will probably continue around previous levels, thus assuring a steady growth in corporate liquidity. In view of this trend, it is a fair inference that there has been no net increase in outstanding notes and securities of these companies in 1943, and that this year some decline will occur as retirements exceed new issues.

These indications point to a residual increase in the cash and temporary investments of these manufacturing companies during 1943 and

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Luts of the Institute for Advanced Study gauges "normal" liquidity requirements by combining cash and marketable securities, and relating them to total cash disbursements rather than to sales. This procedure seems to have a good deal of merit, though it also raises some problems of interpretation. (Professor Luts's study is being prepared as part of the Financial Research Program of the National Bureau of Economic Research.)

1944 at about the same rate[12] as in 1942. In allocating the growing liquidity between cash and temporary investments, it has been assumed that cash holdings would be guided by operating requirements and that all the remainder would go into temporary investments, mainly Government securities. This would mean a substantial increase in purchases of Government securities.

TABLE II

MAJOR SOURCES AND USES OF FUNDS FOR ABOUT 890 MANUFACTURING COMPANIES FOR YEARS 1940–1942 WITH ESTIMATES FOR 1943 AND 1944

(in billions of dollars)

	1940	1941	1942	1943*	1944*
(Sales	29.6	41.1	50.6	61.0	65.0)
Uses of funds					
Increase in receivables	0.5	1.3	1.7	1.1	0.4
Increase in inventories	0.8	2.0	1.1	0.2	0.1
Capital expenditures	1.5	2.2	1.5	0.7	0.7
Retirement of notes and securities	0.1	—	—	—	0.3
	2.9	5.5	4.3	2.0	1.5
Sources of funds					
Increase in:					
Government advances	0.6	0.3	1.8	0.1	—
Accrued income tax liability	0.7	2.0	1.1	0.6	0.3
Trade accounts and other current liabilities	0.4	0.6	0.6	0.7	0.2
Security issues and bank loans	—	0.6	0.4	—	—
Revenue earmarked for: depreciation	1.2	1.5	1.6	1.7	1.8
other reserves	0.1	0.3	0.4	0.6	0.7
Net profit retained after dividends	0.8	1.1	0.9	1.0	1.0
	3.8	6.4	6.8	4.7	4.0
Balance					
Increase in cash	0.9	−0.1	0.9	0.7	0.3
Increase in temporary investments†	0.0	1.0	1.6	2.0	2.2

* Rough estimates.

† Includes restricted deposits and excess profits tax refunds, as well as Government securities.

Prospective liquidity after termination of war contracts.—Assuming these guesses as to liquidity trends to be reasonable, the next question is how the accumulated total will measure up in comparison with cash requirements that may be faced by these companies if war contracts

[12] In contrast to this estimate a midyear analysis of financial statements for 80 war producers, published in the National City Bank letter for September 1943, indicated an increase in liquidity for the first half of last year that was considerably greater than the change in all of 1942. This contrast appears attributable to virtual stability in receivables of the 80 companies, as compared to the expansion postulated in Table II. Since these companies represent about one fifth as large a sample (in terms of sales) as the group discussed in the present memorandum, the contrast between their behavior in 1943 and the prospects outlined here for the larger group may reflect differences in the relative coverage of various industries.

should be terminated at the end of 1944. For many companies, contract termination will mean interrupting production lines for several months while facilities are adapted to civilian products. This period of adaptation, together with the building up of new inventories, will require in the aggregate considerable cash outlays. Their amount will be further increased, before receipts from new sales start coming in, by the extension of usual trade credit to customers.

It is not possible at this time to gauge accurately the length of this conversion period nor the aggregate cash expenditures that may be required during it. One reason for this is that there will be no single date when the war contracts of all companies are terminated. Other factors affecting the need for cash and the ability of corporations to provide them include (1) the amount of contingent liabilities carried over from war operations (such as for dismissal wage payments and outlays for reestablishing markets); (2) the amount of discretion allowed manufacturers in cutting pay roll costs immediately after contract termination or alternatively of including interim pay rolls in the amounts due from the Government; (3) the level and distribution of corporate taxable income, which will affect the available amount of tax refunds; (4) the scale on which manufacturers will plan to resume civilian production; (5) the backlog of deferred maintenance and postponed capital replacement; (6) the terms on which Government owned plants, equipment, and surplus material can be purchased or leased, and other factors, some of which are dependent on legislative action in the interim. Questions of timing, as well as the amounts involved, will be important in some industries (such as aircraft) where net working capital is small relative to the scale of wartime operations.

For illustrative purposes, we can, however, obtain some indication of what will be involved at the beginning of the postwar adjustment by assuming that all contracts will be terminated at the end of 1944, and that various balance sheet items will have to be adjusted back to 1941 levels. That is, we may first see what funds would be required to retire current liabilities (including such bank loans for war production as are not under Regulation V), and to build up civilian inventories and receivables. Then we may go on to compare these requirements with the amounts that may be obtained from liquidating wartime inventories and receivables, from opening new accounts payable and accruing other current liabilities (up to the 1941 level of operations), and from drawing down wartime accumulations of cash and marketable securities. For the manufacturing companies in our analysis, these adjustments add up as shown in Table III.

This comparison brings out the strategic importance of Government policy with regard to settlement of war contracts. As shown in the table, if working funds already invested in wartime inventories and receiv-

TABLE III

HYPOTHETICAL REQUIREMENTS FOR FUNDS AND THEIR SOURCES, IN ADJUSTING CURRENT POSITION OF 890 MANUFACTURING COMPANIES TO CIVILIAN BASIS IN 1945

(in billions of dollars)

Requirements for funds	
Retire 1944 current liabilities except bank loans	12.5
Retire bank loans not under Regulation V*	0.5
Replace inventory and receivables (1941 level)†	13.2
Total	26.2
Sources of funds	
New current liabilities (1941 level) except bank loans and Government advances	6.1
Draw down cash and marketable securities to 1941 level‡	7.7
Liquidate 1944 inventory and receivables†	17.8
Total	31.6
Subtotal, excluding inventory and receivables	13.8
Subtotal, including 75 per cent of inventory and receivables	27.2

* Total bank loans for war production not arranged under Regulation V may be about 1.5 billion at the end of 1944, and it is assumed that one third of these will be to the large companies included in the present analysis.

† To the extent that some wartime inventories will be retained for use in civilian production, this item will be smaller than shown here, and the totals, both of requirements and of sources, will be correspondingly lower.

‡ Including postwar refund of excess profits tax.

ables should be frozen after termination of contracts, manufacturers would need additional financial aid for about half their total working capital requirements in the transition period. On the other hand, if arrangements should be concluded for immediate payment to manufacturers of the bulk of their contract claims, say 75 per cent or more, these companies would (in the aggregate) be able to meet their working capital requirements, and would require outside financing only for such other reconversion costs and capital expenditures as are not mentioned in the table.

Finally, as an outside limit, it appears that complete settlement for wartime inventories and receivables within a year might facilitate the release of some 5.4 billion dollars for such special war costs. This sum would probably be augmented during the first transition year by additional funds, amounting perhaps to 1 billion dollars from revenue allocated for depreciation and another billion from retained net income.[13]

[13] Some additional amounts may also be obtained as income tax credits under the revenue code provisions for carry-backs and for accelerated amortization of defense facilities after termination of the

Thus in the event that settlement of Government obligations could be effected expeditiously, the adjustments in current position plus current earnings of these companies, covering over half of all manufacturing industry, would provide 7 to 8 billion dollars for various contingency costs and new capital expenditures, without resort either to the banks or to security markets for further funds.

TABLE IV

MAJOR OPERATING ASSETS AND LIABILITIES FOR ABOUT 890 MANUFACTURING COMPANIES FOR DECEMBER 1935–42 WITH PROJECTIONS FOR 1943 AND 1944

(in billions of dollars)

	1935	1936	1937	1938	1939	1940	1941	1942*	1943†	1944†
Major operating assets										
Net property account‡	13.31	13.69	14.50	14.00	14.58	14.87	15.58	15.50	14.50	13.40
Cash	2.32	2.35	2.16	2.84	3.31	4.19	4.07	4.99	5.70	6.00
Temporary investments§	1.08	.99	.83	.77	.89	.93	1.89	3.52	5.70	7.70
Inventories	4.96	5.63	6.60	5.89	6.15	6.90	8.89	9.99	10.15	10.30
Receivables	1.98	2.37	2.32	2.27	2.58	3.04	4.30	5.95	7.10	7.50
Major operating liabilities										
Accounts payable	.77	.98	.89	.81	1.02	1.23	1.67	2.05	2.45	2.60
Income tax liability	.27	.45	.54	.30	.47	1.15	3.12	4.24	4.80	5.10
Government advances	—	—	—	—	.10	.70	1.00	2.80	2.90	2.90
Other current liabilities	.72	.85	.88	.86	.96	1.10	1.28	1.47	1.80	1.90
Surplus reserves	.80	.84	.86	.82	.85	.93	1.18	1.64	2.20	2.90
Outstanding securities¶	16.66	16.87	17.55	17.76	17.68	17.55	18.13	18.50	18.50	18.20
Selected income items										
Sales	19.90	24.60	28.24	23.61	25.58	29.59	41.11	50.64	61.00	65.00
Depreciation expense	.94	.99	1.08	1.07	1.15	1.24	1.45	1.60	1.70	1.80
Net income	1.50	2.33	2.52	1.24	2.06	2.48	2.93	2.42	2.66	2.60
Dividends declared	1.01	1.70	1.88	1.13	1.44	1.66	1.81	1.51	1.66	1.60

* Preliminary.

† Estimate based on continuance of full scale war production.

‡ After deducting depreciation reserves.

§ Includes restricted deposits and post-war refund of EPT, as well as tax notes and other government securities.

¶ Includes notes payable but excludes amount equal to investments in affiliates.

This, of course, does not necessarily mean that there will be no outside financing by these companies in the reconversion period. Doubtless there will be many individual companies which will need to make reconversion expenditures in excess of their available cash reserves, and others which will wish to initiate the financing of new products or production techniques. It does not seem possible at this time to estimate how large this financing may come to.

emergency period. For present purposes, however, little account need be taken of the former possibility, because amounts from this source would be more than offset by failure of net profits to reach the level assumed here.

THE CONCEPT OF PRODUCTIVE ACTIVITY

By Irving H. Siegel*

This paper is devoted to the discussion of various aspects of the concept of productive activity. This concept, like many we seek to quantify, may be represented in various ways, some of which are more appropriate than others. Ideally, it may be represented by the input of productive services or by the net economic product to which that input corresponds. Both measures describe the same activity—the creation of valuable utilities—but from different sides and in different terms. As will be seen later, both may be made almost identical for a single period, but indexes will usually diverge. Since such measures may be difficult or even impossible to construct in practice, more or less correlated measures—like the volume of raw materials consumed or the volume of goods completed or shipped by establishments—are commonly substituted. Only by giving some precision to the concept we wish to measure can we make rational choices among such substitutes or appraise the differences between them and ideal measures.

In this paper, the representation of activity in terms of both input and product will be treated, but more attention will be given to measures of the latter type, which are conventionally preferred and probably more significant from an economic standpoint.[1] For the sake of brevity and simplicity, the discussion will be limited to manufacturing; and no reference will be made to many familiar problems and controversial issues of economic measurement. No choice, for example, will be made among possible definitions of value added or income originating in an industry. Index-number problems, such as the selection of a formula and weights and the satisfaction of certain algebraic tests, will largely be ignored. And certain temptations arising in the contemplation of "fundamentals" will be resisted: efforts at statistical vivisection will not be declared futile simply because money is a defective indicator of economic value where perfect competition does not reign, because other indicators of value have even more serious limitations, because prices and other weighting factors are not really independent of quantities, and because periods characterized by different tastes, commodities, income distributions, and technologies are essentially noncomparable.

* On military leave from U. S. Bureau of Labor Statistics.

[1] For an exchange of views on indexes of input (and other subjects) by M. A. Copeland and E. M. Martin, S. Fabricant, and M. Friedman, see *Studies in Income and Wealth*, Vol. II (New York, 1938) pp. 85–135.

ACTIVITY IN TERMS OF PRODUCT

An ideal measure of the productive activity of an establishment or industry should reflect the transformation of raw materials into partly finished as well as completed goods, and the further elaboration as well as the mere completion of goods already in process. It should be relatively neutral to the time unit selected for measurement and the time cycle of the productive process, to the degree of integration of manufacturing facilities, and to the degree of interdependence of establishments classified in the same or different industries. Though these specifications introduce no special difficulties into the measurement of input, they do impose certain restrictions on measures of product intended to reflect activity. The remainder of this section will be devoted to the consideration of activity in terms of product.

In accordance with the view expressed above, the accomplishment of a plant should be described, if possible, not in terms of its final products, but in terms of subproducts of particular operations, sequences of operations, or departments.[2] Thus, each type of finished good should be regarded as a complex of subproducts associated with, say, the unitary processes shown on a more or less detailed flow chart. The characteristic subproducts of auxiliary departments—like the power plant—should be taken into account as well as the subproducts of operating departments. Different goods made in the same plant should, in general, be treated as distinct sets of subproducts, but homogeneity may be assumed for similar or joint operations. The same goods made by dissimilar methods—for example, in different plants—may be regarded as different goods; or be treated as complexes of comparable subproducts by the appropriate grouping of sequences of operations directed toward comparable ends.

Evidently, even one good may be described by alternative systems of subproducts. Criteria may, however, be established to distinguish acceptable from unacceptable systems. The time required for each of the unitary processes defining a subproduct system should be shorter than the period of measurement. The more refined the process intervals, the more precise the evaluation which can be made of work done on those units of goods which do not go through the complete fabricational cycle during a period.

Measures based on appropriately weighted subproducts would reflect the volume of activity during a period much more satisfactorily than the common aggregative measures of gross product, which are

[2] S. Carlson, in *A Study of the Pure Theory of Production* (London, 1939), pp. 10–11, uses the term "technical unit" to define the distinctive stages of an establishment's activity.

based merely on the volume of maturing goods and unit-value weights. They are also superior to the measures of net product often regarded as ideal—in which the quantities of maturing goods are weighted by value added per unit during the complete production cycle. It is important to observe that the volume of *complete* plant products corresponding to the amounts of the several subproducts made during a period may differ significantly from the volume of goods merely *completed* during that period. Measures based on finished goods are unreliable for periods in which relatively more subproducts are made at the earlier stages of the productive process; for plants or industries which are not completely integrated or which undergo changes in degree of integration; and for plants or industries having a long production cycle compared to the measurement period.

The approach outlined here is not incompatible with the modern economic view of production and the theory underlying the measurement of national income.[3] A somewhat similar approach is suggested by H. S. Jevons' treatment of "work" as the "amount of labor in terms of commodity produced." His "commodities" are really subproducts or units of accomplishment:

> Work is not always of the nature of actual making of commodities: it may consist merely of moving commodities from place to place, or of making such an insignificant portion of the object planned—as for instance, bolting a plate on a ship's hull—that the labor of such a period of time as we may wish to consider does not produce a commodity; or again it may be devoted to the destruction of things—as pulling down houses; or to the removal of discommodities.[4]

A number of difficulties, in addition to the unavailability of sufficient data in suitable form, would be encountered in any attempt to measure activity in terms of subproducts. Some awkwardness, for example, would arise in the treatment of acceptable work done on goods which are not ultimately used as intended—say, because of imperfections, design changes, or the cessation of hostilities. It is impossible to determine beforehand just what activity will contribute, not to the satisfaction of wants, but to the diversion of resources. A similar problem arises in measures based on finished goods, but is usually ignored.

Activity cannot readily be expressed in terms of subproducts or units of accomplishment in the absence of a certain uniformity or repetitiveness of operations. The work of some auxiliary departments—like those engaged in maintenance, construction, or making tools, dies, jigs, and fixtures—is not standardized. The same difficulty may be en-

[3] See, for example, the very illuminating first chapter of S. Kuznets, *National Income and Its Composition, 1919–1938* (New York, 1941), Vol. I. The discussion of the meaning of "produced" and the timing of production, pp. 46–50, are particularly relevant.

[4] H. S. Jevons, *Essays on Economics* (London and New York, 1905), p. 164.

countered in attempts to measure work done in certain operating departments, in new plants, in plants converting from one type of product to another, and in plants or industries in which the nature of the activity varies according to season. Finally, there are temporal changes—in the process or output of an establishment and in the establishments composing an industry—which must be taken into account in the definition of a subproduct system. Where devices already discussed are inadequate, it may be feasible to express activity in different periods in terms of hypothetical standard work units. At worst, the attempt to measure activity in terms of product may be abandoned in favor of the measurement of input.

MEASURES OF ACTIVITY

Activity in a single period may be represented by measures of input and net product which are virtually equal. Thus, if money is used as a common measure, it is possible to have for the period t_0

$$\sum v_0 s_0 = \sum p_0 q_0 - \sum P_0 Q_0, \tag{1}$$

where the v_0 and s_0 represent average prices and quantities of productive factors; p_0 and q_0, the average prices and quantities of the subproducts made in t_0; and P_0 and Q_0, the prices and quantities of subproducts and of products and services of other establishments and industries consumed in t_0. Equality cannot obtain unless the subproducts are so narrowly defined that all the work done during the period on stocks of unfinished goods is automatically recorded. The prices p_0 and P_0 must also be such that the difference between them embraces exactly those services which are included in the left-hand member of the equation. Incidentally, the same result would be achieved if zero prices were assigned to all materials and services obtained from other establishments or industries; only consumed subproducts of the establishment would have non-zero P_0, and the p_0 would include only value added within the establishment.

If the subproducts are so defined that one unit of each corresponds to one unit of a consumed antecedent subproduct, material, or service, then the right-hand member of (1) may readily be written as the sum of quantities weighted by unit value added:

$$\sum p_0 q_0 - \sum P_0 Q_0 = \sum q_0 \left(p_0 - \frac{P_0 Q_0}{q_0} \right). \tag{2}$$

If a one-to-one correspondence does not exist, then the right-hand member of (2) must be written in somewhat more complicated form; the $P_0 Q_0$ must be replaced by a sum, and, accordingly, the sum $\sum P_0 Q_0$ on the left must be replaced by a double sum. This complication is often overlooked in the literature.

Similar equations may be established for any single factor or combination of factors intended to represent activity. Since payments to such factors as capital and salaried labor are fixed for short periods, it may be preferred, for example, to consider only wages or the man-hours of wage earners. It may also be preferred to substitute depreciation charges for interest if the former are computed on the basis of output rather than time.

If we wish to represent activity in t_0 by man-hours, we may write

$$\sum m_0 = \sum q_0 l_0, \tag{3}$$

where the m_0 signify man-hours added, q_0 the quantities of subproducts, and l_0 the corresponding unit labor requirements. The left-hand member of (3) may also be written as the difference between cumulated man-hours at successive stages of the productive process. The man-hours corresponding to goods or services of other establishments or industries are, of course, ignored—that is, counted as zero.

If we wish to represent activity by wages, we may write

$$\sum m'_0 r'_0 = \sum q'_0 l'_0 r'_0 = \sum q'_0 c'_0, \tag{4}$$

where the m'_0 represent man-hours, but not necessarily the same as the m_0 in (3); the q'_0, l'_0, and r'_0 represent quantities of subproducts, unit labor requirements, and average hourly earnings, respectively; and the $c'_0 = l'_0 r'_0$ are unit labor costs corresponding to the q'_0. Keynes uses the equivalent of the input measure, $\sum m'_0 r'_0$, to reflect the output of individual establishments; his m'_0 and r'_0 refer to the quantity and remuneration of labor of different skills.[5] From our point of view, the q'_0 implied in this case are subproducts relating specifically to these skills.

Indexes of activity may be defined as ratios of expressions such as those above for the periods t_i and t_0. More satisfactory indexes are obtained if all of the weights are standardized to refer to one period, such as t_i, t_0, or even a hypothetical one. Indexes of input and product with standardized weights are generally unequal, even if equations like (1), (3), and (4) are satisfied for t_i and t_0. An input-product equation for one period is destroyed by the introduction of weights for another. The process of standardization is equivalent to "deflation" of the ratio of the unadjusted expressions for t_i and t_0 by an index which is conceptually and algebraically appropriate.

The indexes of input and output with t_0 weights corresponding to (1) are

$$\frac{\sum v_0 s_i}{\sum v_0 s_0} \text{ and } \frac{\sum p_0 q_i - \sum P_0 Q_i}{\sum p_0 q_0 - \sum P_0 Q_0}, \tag{5}$$

[5] J. M. Keynes, *General Theory of Employment, Interest, and Money* (New York, 1936), pp. 40–45.

respectively. The product index may also be written as

$$\frac{\sum p_0 q_i - \sum P_0 Q_i}{\sum p_0 q_0 - \sum P_0 Q_0} = \frac{\sum q_i \left(p_0 - \frac{P_0 Q_i}{q_i} \right)}{\sum q_0 \left(p_0 - \frac{P_0 Q_0}{q_0} \right)} \tag{6}$$

if (2) is meaningful, and in a more complicated form if (2) is not. An approximation to (6) is the aggregative index,

$$\frac{\sum q_i \left(p_0 - \frac{P_0 Q_0}{q_0} \right)}{\sum q_0 \left(p_0 - \frac{P_0 Q_0}{q_0} \right)}, \tag{7}$$

with t_0 weights. These indexes resemble those shown by Fabricant[6] for an industry, but differ in at least one important respect: the quantities here include subproducts, some of which may be consumed in further fabrication in the same plant during the same period.

The unadjusted index of wage-earner man-hours,

$$\frac{\sum m_i}{\sum m_0}, \tag{8}$$

is a practical and widely used measure of input changes. Although man-hours for different periods are often compared directly, it may be preferred to standardize them first, to eliminate interperiod qualitative differences. Thus, productivity or unit labor requirements may first be standardized for a definable set of tasks, a common system of subproducts on which the labor is, or could be, expended in t_i and t_0. If unit labor requirements are standardized to refer to t_0, we have

$$\frac{\sum m_i \frac{l_0}{l_i}}{\sum m_0} = \frac{\sum m_i \frac{\pi_i}{\pi_0}}{\sum m_0}, \tag{9}$$

where the $\pi_i = 1/l_i$ and $\pi_0 = 1/l_0$ represent productivity, or output per man-hour for the different subproducts. This adjusted index of labor input is really a measure of product which corresponds to the right-hand member of (3), for

$$\frac{\sum m_i \frac{l_0}{l_i}}{\sum m_0} = \frac{\sum q_i l_0}{\sum q_0 l_0}. \tag{10}$$

[6] S. Fabricant, *Output of Manufacturing Industries, 1899–1937* (New York, 1940), pp. 23–33. See also his article on "Problems in the Measurement of the Physical Volume of Output by Industries," this JOURNAL, September 1938, pp. 564–570.

If all the π_i/π_0 or l_0/l_i are equal to unity, (9) or (10) is equal to the unadjusted measure (8).

The adjusted man-hours index may, of course, be derived alternatively by the deflation of the unadjusted index by an appropriate index of unit labor requirements, or by the multiplication of the former by the reciprocal of the latter, which is an index of productivity. As will be seen in the next section, it is often erroneously assumed that any index presenting productivity is satisfactory, that the derived production measure is unique, and that a proper production index may somehow be obtained by deflation where no subproduct system common to t_0 and t_i is, or can be, specified. The symbol $\sum q_i l_0$ in (10) is meaningless if the $q_i l_0$ do not refer to the same subproduct system as the $q_0 l_0$ in $\sum q_0 l_0$. In cases of discontinuity of a plant's or an industry's activity, continuity in types of labor employed may provide some basis for defining a common subproduct system. If the nature of the work force has also changed radically, no satisfactory adjustment for presumed productivity changes between t_0 and t_i may be possible.

A measure of labor input which is preferable to the unadjusted man-hours index (8) is suggested by the first term in (4). Using t_0 weights, we have

$$\frac{\sum m'_i r'_0}{\sum m'_0 r'_0}. \tag{11}$$

Whereas (8) implies the homogeneity and additiveness of all man-hours, (11) differentiates them on the basis of hourly earnings. Another measure of labor input, in which adjustment is made for differences in unit labor cost between t_0 and t_i, is equivalent to the index of product suggested by the second and third expressions in (4):

$$\frac{\sum m'_i r'_i \dfrac{l'_0 r'_0}{l'_i r'_i}}{\sum m'_0 r'_0} = \frac{\sum q'_i l'_0 r'_0}{\sum q'_0 l'_0 r'_0} = \frac{\sum q'_i c'_0}{\sum q'_0 c'_0}. \tag{12}$$

In practice, (11) and (12) are even more difficult to approximate than (9) and (10). The former, incidentally, is equivalent to the quotient of the payrolls index and an appropriate index of hourly earnings, and the latter is equivalent to the quotient of the payrolls index and an appropriate index of unit labor cost.

The various indexes of input or net product discussed above will usually differ from each other and from corresponding indexes with weights referring to other periods. The conditions determining the relative magnitudes of aggregative indexes for the same factors or subproduct systems but with different weights have been considered by the present

writer in other articles in this JOURNAL.[7] It may be of interest to note here the relationship existing among product indexes with different factor weights (expressed in money). In a single period, say t_0, it is obvious that

$$\sum q_0 w_0 = \sum q_0 a_0 + \sum q_0 b_0 + \sum q_0 c_0 + \cdots , \qquad (13)$$

where the w_0 represent unit values added, and the a_0, b_0, c_0, $\cdots$ represent factor costs per unit of product, so that $w_0 = a_0 + b_0 + c_0 + \cdots$. The product index with unit-value-added weights, which corresponds to (7), may then be written as follows in terms of the indexes with factor weights:

$$\frac{\sum q_i w_0}{\sum q_0 w_0} = A \frac{\sum q_i a_0}{\sum q_0 a_0} + B \frac{\sum q_i b_0}{\sum q_0 b_0} + C \frac{\sum q_i c_0}{\sum q_0 c_0} + \cdots , \qquad (14)$$

where $A = \sum q_0 a_0 / \sum q_0 w_0$, etc. and $A + B + C + \cdots = 1$. This result, which may be extended to refer to an aggregative index of gross product, is equivalent to the "general linear equation" derived by Roy in another connection—the integration of Divisia's differential index-number formula.[8]

SOME CURRENT INDICATORS OF ACTIVITY

In the light of the foregoing, we shall now consider briefly some current series which are intended or interpreted as measures of activity in terms of product. First, we shall comment on indicators of the accomplishment of war industries. For obvious reasons, emphasis in these industries is placed on deliveries of finished goods—acceptances by government agents. A satisfactory delivery rate, however, may not signify a satisfactory activity rate, on which future deliveries depend.

In one major war industry, shipbuilding, a distinction is made between deliveries and work done. The Navy and the Maritime Commission not only record the number and tonnage of vessels delivered each month but follow peacetime Census practice in estimating accomplishment during the same period. Although the time interval between keel-laying and delivery has been reduced considerably, it is still too long, at least in the case of larger vessels, for a high correlation between activity and deliveries. In the airplane assembly industry, the same Census practice has been abandoned, and only deliveries are reported. Under conditions of near-capacity production throughout a large section of our economy, the time cycle for the fabrication of many ma-

[7] "The Difference between the Paasche and Laspeyres Index-Number Formulas," September 1941, pp. 343–350; and "Further Notes on the Difference between Index-Number Formulas," December 1941, pp. 519–524.

[8] R. Roy, "Les Indexes Economiques," *Revue d'Economie Politique*, 1927, pp. 1272–1274.

terials and parts as well as for the assembly of complex equipment may be sufficiently long to suggest caution in the interpretation of data on shipments or deliveries.[9]

A few instances in which deliveries proved unreliable as indicators of activity will now be cited from press reports. The War Production Board munitions index (November 1941 = 100), which apparently is based on work done in shipyards and on value-weighted quantities of goods delivered, rose from 435 in November 1942 to 496 in December but receded to 457 in January 1943. The explanation was given that "assembly lines were stripped . . . to produce as many units as possible" before the year-end, so the record for January was "adversely affected" by December's "excellent showing."[10]

When the WPB index showed no change in munitions output between April and May 1943, dissatisfaction with the "yardstick" was expressed. Curiously enough, an objection was raised against the representation of shipyard activity by work done, which lagged behind deliveries:

> To officials who have been preening themselves upon the delivery of a record 100,000 deadweight tons of merchant ships during May, it came as a bitter jolt to discover that the production report showed the "value of work done" in shipyards for the month had declined 4 per cent compared with April.
>
> The "value of work" measurement was adopted early in the war when construction was getting under way and was then considered a fair way of reflecting progress made. Its worth is open to question from WPB officials now, however, when record launchings of ships do not show up in proper proportion in the production picture.[11]

In June 1943, the displacement tonnage of naval vessels delivered rose 13 per cent above the May level to a new peak; "because 'the value of work put in place' in shipyards is used in measuring output, however, the month's report showed a 3 per cent decline."[12]

Plane deliveries have frequently been affected by temporary bottlenecks in subsidiary industries and by accidental factors which have little bearing on activity in assembly plants. In October 1942, plane deliveries fell 5 per cent below the number for the preceding month. The decline reflected "the bunching of deliveries on Sept. 30, many of which under normal circumstances would have been delivered in Octo-

[9] For illustrations of time requirements for materials entering into various war goods, see American Iron and Steel Institute, *Steel Facts*, June 1943, p. 5, and August 1943, p. 5, and *Aero Digest*, October 1943, pp. 222, 224.

[10] *New York Times*, February 3, 1943.

[11] *New York Times*, July 18, 1943.

[12] *New York Times*, July 31, 1943.

ber, and the grouping of deliveries on Nov. 1, many of which would have been included in October shipments." One large manufacturer indicated that weather interfered with test flights so that 59 planes completed in October "were not accepted until Nov. 1."[13] The total reported for December 1942 suggests other problems in interpretation. The figure for that month included "several hundred planes which were accepted but went into the 'pool' on the last day of the month." The planes in the "pool" may not be in flying condition; they may lack "some part—a propeller, wheels, instrumentation or other essential items."[14]

In conclusion, some comments will be made on the Federal Reserve indexes of manufacturing activity (1935–39 = 100), which are compiled monthly.[15] These measures are based on quantities of goods made per scheduled workday in each month; on consumption, sales, deliveries, and shipments; and on machine-hours and man-hours, adjusted in most instances to show probable changes in volume of product. The weights used in the composite manufacturing index and in the index of "industrial production," which includes both manufacturing and mining, represent value added in 1937. In September 1941, the scope of the composite indexes was broadened to include government manufacturing activity in shipyards, arsenals, and quartermaster depots, but no weights were formally assigned to the series representing such activity.

Despite the lavish application of ingenuity to intractable data, many of the Federal Reserve measures may fail to reflect reliably the course of activity in terms of product. The weighted quantities of electric and other types of steel may not, for example, reveal the changes taking place in steelworks, rolling mills, and other industries in the iron and steel group. The activity of fabricators may also be inadequately portrayed by the volume of material shipped to or consumed by them (even if the amounts are first adjusted for timing), or by their shipments of finished goods, or by the volume of goods completed.

A striking feature of the Federal Reserve indexes since the 1940 revision is the inclusion of adjusted man-hours to represent current activity in industries having a long production cycle, making numerous or heterogeneous goods, or manufacturing products which differ from their peacetime output. After the December 1941 revision, man-hours series accounted for 38 per cent, and after the October 1943 revision

[13] *New York Times*, December 8, 1942.

[14] *New York Times*, February 3, 1943.

[15] The discussion of the Federal Reserve indexes is based largely on the descriptions given in the *Federal Reserve Bulletin*, August and September 1940, September 1941, and October 1943.

41 per cent, of the base-period aggregate for private manufacturing. Such series account for even greater percentages of aggregates for more recent periods and of aggregates which include government manufacturing.

After the October 1943 revision, the indexes for government manufacturing and for industries representing about 22 per cent of the 1935–39 private manufacturing aggregate are based on man-hours adjusted directly for presumed productivity changes. The "allowances" for "broad changes in output per man-hour," however, leave much to be desired. They are derived independently from various types of data, are based on no particular subproduct system, and may yield a result which differs considerably from the theoretically ideal product measure. Even if ideal data were available, it might be difficult or impossible to define a common subproduct system for the measurement of productivity change in an industry which has converted to war production, makes complex goods of changing design, subcontracts parts, etc. Finally, the assumption that short-term productivity movements are smooth and capable of extrapolation appears untenable, no matter how productivity is defined.[16]

Indexes for industries representing about 17 per cent of the 1935–39 aggregate for private manufacturing are based on monthly man-hours adjusted to quarterly or annual levels determined from production and other data. Even if such data give reliable indications of activity changes in terms of product between quarters or full years, they may not be conceptually appropriate for shorter periods. The adjustments may not improve the month-to-month changes shown by man-hours. The index for rubber products, representing less than 2 per cent of the base-period manufacturing aggregate, is based on unadjusted man-hours. This series corresponds to an index of product if a standard subproduct system can be defined and the correlative productivity measure has the constant value unity.

[16] It may readily be verified that, even when crudely defined as the volume of goods completed or shipped per man-hour, productivity fluctuates from month to month. The average effectiveness with which labor is utilized in making subproducts is influenced not only by mechanization and technological advances but also by a host of short-term factors: temporary idleness caused by faulty scheduling, material shortages, design changes, conversion of facilities to production of other goods, accidents, or strikes in subsidiary industries; hiring of labor for training; hoarding of workers who may later be released or more productively employed in the same establishments; wastage of labor on rejects and expenditure of additional effort on salvage; etc.

SOME PROBLEMS OF STATISTICAL EDUCATION AND TEACHING*

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I. While Dr. Stuart A. Rice, in his article on statistics in the United States during the war,[1] gives us the idea that in the United States there is appearing, in certain fields of action, what might be termed an exaggeration of the statistical mind ("espíritu estadístico"), we must confess that the situation is quite the opposite in many of the other countries of this hemisphere.

From Mexico to the Argentine we can find economic, political, and social publications in which the authors complain of the lack of reliable figures relating to one urgent problem or another and in which they emphasize the absolute necessity for a better organization of the statistical services of their respective countries.

Many of these countries have attained a high degree of industrialization and of economic life in general. Nevertheless, it may be said that their statistical organizations are still at a level inferior to that attained by European countries smaller in population and less important in international trade.

II. Analyzing the possible reasons for this state of things, we may present the following items as mainly responsible for the absence of the "statistical mind" in many countries of Latin America.

1. The colonial economy continued to be the typical form of economic organization in most of the countries of Latin America for a long time after the attainment of political independence, and even now it has not altogether disappeared. The colonial economy may be defined, for the purposes of this article, as that state of things in which the large businesses, plantations, lands, mines, etc., are found in the hands of foreigners either resident in foreign countries or living only for the time being in these American countries. The sole object of these business enterprises is to make the largest possible profits in the least possible time. They are not concerned with building up a permanent

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[1] United States Statistics in Wartime, *Estadística*, Vol. I, No. 1, p. 31.

organization or with extensive and costly economic investigations undertaken to find out small differences in the expenses of operation or of administration or of improvements. The profits of these undertakings have been in general so large and so quickly realized that it would have been an expenditure absolutely unnecessary to invest money in scientific statistical investigations, analysis of markets, possibilities for the distant future, etc.

2. Another reason without any doubt is the extensive political instability which has characterized the history of Latin America since the wars for independence. We must never forget that statistics, especially in the economic and social fields, cannot possibly develop except where there is a well organized public administration with a fairly extensive continuity. It is exactly the lack of this continuity in public administration (civil registers, industrial records, immigration, emigration, morbidity, etc.) which interrupts any historical series sooner or later. It would be difficult in most cases to establish with certainty the figures for immigration, birth rates or death rates, or circulation of money, for example, as far back as the year 1860.

3. If these two circumstances have their foundation in history, they have created a state of thinking which is in the highest degree of the present and which is characterized by just this lack of the statistical mind, of respect for figures. The public official and the man in the street go on thinking in indefinite quantities, in terms of "much" and "little." If the public official in the United States sometimes wastes time because he is afraid to adopt some measure without having as a base a pile of statistical tables, many of them perhaps unnecessary, quite the opposite happens in many cases in Latin America. Measures are adopted without any statistical base or with one very unsatisfactory, but without losing time. Does it always depend on the particular circumstances, which of these two extremes is the more dangerous?

III. It is evident that this state of things cannot be changed overnight by decrees, laws, Pan American agreements, or scientific congresses alone. The statistical way of thinking can be attained only as the result of a broad campaign of education comparable with certain campaigns undertaken in the fight against certain epidemics or unhealthy and antisocial customs. This inter-American statistical campaign will involve two principal fields of action.

a. The statistical education of the public in general. In addition to the general advertising program always undertaken by national governments when there is in prospect a census or new fiscal or administrative procedures, the statisticians of all the American countries would have

to contribute to the building up of a "respect for figures." By means of conferences, statistical societies, publications, etc., we must demonstrate the absolute necessity for statistics in all branches of public, economic, political, and even individual life. The manufacturer or merchant must understand that the figures which the Statistical Office asks him to furnish are not professional secrets, but that these same data, worked up and published together with others of the same kind, will help him understand the economic situation and facilitate decisions in his own business. Newspaper men in their publications, and politicians in their speeches, would have to discuss the current questions, using statistical data when possible, and not only to use statistical data in support of their own opinions but also to call attention to the lack of exactness in such data when they are trying to attack the opinions of an opponent. In other words, statistics must undertake a sales drive in all countries where it is needed. And it appears that there are many of these.

b. If by this statistical education we create the demand for our products, which are statistical figures, we must logically concern ourselves to an equal or greater degree with their production. And we cannot produce results without having a personnel sufficient in number and adequately prepared. The next thing to be considered, then, is effective statistical instruction. This instruction must have for its aim the development of a well qualified statistical personnel in the countries of the Americas, including in this concept of personnel, not only the men who direct the central offices and the principal subdivisions, but also the employees of all ranks in the hierarchy, from the lowest to the highest. The necessity for a complete "vertical" coverage in the system of teaching will be understood if we compare the statistical office with a hospital or a factory. It is not sufficient to have a physician of the highest qualifications as head for the one or a competent engineer for the other. Neither of these can produce good results if he is not supported by subordinates equally competent and well qualified. The physician cannot attend to his patients without the aid of well-trained medical assistants, pharmacists, nurses, and even cooks; the industrial plant will be very soon paralyzed if the chief engineer does not have the aid of experienced technical assistants, draftsmen, mechanics, and office workers. For the same reason it is absolutely not enough that the director of a statistical office or the chief of a section understand well the matters under his jurisdiction. In order to work effectively the whole statistical personnel must have specific training, graduated according to their various functions and responsibilities.

IV. What is the present state of statistical instruction? In general, this subject appears only in the programs of the universities (faculties of economic, social, and commercial science, etc.). It might be said as a general rule, with many exceptions, that the following shortcomings may be observed in this university instruction and in the university programs:

a. The number of students and the number of persons trained by the faculties is necessarily limited in comparison with the present needs and even more if we think of the future.

b. A graduate of the university bears the title of doctor or "licenciado" and is no longer willing to accept the humble task of assistant in a statistical office. And it is exactly in the lower stages of the hierarchy that there is the greatest lack of qualified personnel.

This program of statistical instruction cannot be considered as an adequate preparation (speaking in general terms) for the professional activities of the statistician.

One should not make so serious a statement as this without giving reasons in support of it. We may therefore point out the following as the principal deficiencies in many of the statistical programs in the universities, European as well as American:

1. The lack of sufficient time devoted to actual practice. In some programs statistics is given only for a half year, without special sessions for practice (laboratory work, so called) or even for analyzing a reasonable volume of specific statistical data.

2. A statistical program purely mathematical. There are programs which belong rather in a faculty of pure mathematics than in one of economic science. The student who follows these programs can perhaps, once he has completed the course, explain the derivations of some of the most complex formulas used in higher actuarial mathematics or in the fitting of biometric curves, but he will be completely unable to organize the collection of statistics of foreign trade, of a bank, of a business, or of a public health department. He will be able, eventually, to work out correlations, more or less artificial, but he will not be able to read and compare the statistics of imports of two countries which use different methods for determining the basic values in commercial transactions. In many cases, after having devoted several years to practical work, even in high positions, he will admit that 80 per cent of the knowledge which he obtained in the university represents dead weight for him, and that it is neither needed nor of any possible use.

We can be sure that this exaggerated notion of the importance of pure mathematics in statistical training comes to us from a period in

which statistics was applied only in demography, biometrics, and in the exact sciences, when it was sought at all costs to elevate statistics to the rank of a sister of that same mathematics. This concept is no longer current. Statistics has been converted into an auxiliary science applied in a great number of practical and scientific fields; and for reasons which cannot be explained here for lack of space mathematics must give ground, in the practical application of statistical methods, to a knowledge of organization, administration, filing (classification), and above all, to a knowledge of the particular material to which the statistical investigation relates.

This exaggerated opinion of mathematical formulas, aside from forming scientific dead baggage for many of those who study statistics, impedes the popularization of these very statistical methods, a popularization so much needed in all the countries of the world and especially in this continent. It is necessary to get rid of the popular notion that statistics is the science that teaches how to manipulate the figures collected, by means of highly complicated formulas, in order to obtain results little understandable and sometimes contradictory to common sense. We must show that by means of relatively simple methods it is possible to collect and analyze data which will be clear and easily understood by a man at the ordinary intellectual level and with no more than a general scientific preparation.

Let us pass from criticism to positive suggestions and see on what general principles a program of statistical instruction could be established in the countries of this continent.

V. Adequate programs of statistical training must incorporate among their aims the following:

a. To transmit statistical knowledge to a large number of persons in each country, not only to public employees, present and prospective, but also to private employees in commerce, industry, medicine, etc. To attain this end it is necessary to take a part of the statistical teaching out of the academic atmosphere of the university and to place it in secondary, professional, and special schools. The existing faculties with statistical programs could assist very effectively in this by establishing special courses in statistics outside the university.

b. To set up programs for these courses, and likewise for those of the university faculties, if possible, in such fashion as to permit a gradation in the subject matter and a differentiation or subdivision of the program. This differentiation will take two forms: (1) Vertical, and (2) horizontal.

1. Vertical differentiation: This term indicates that in the study of

statistics there are various stages of accomplishment, so arranged that the completion of each stage or grade permits the practical application of that which has been learned so far, in the professional work of the student.

2. Horizontal differentiation: This term refers simply to specialization in study in accordance with the practical field in which the student wishes to apply his statistical knowledge. The special fields might be, for example, economic statistics (with possible subdivisions, such as commerce, industry, agriculture, and banking), social statistics, public health, private industry (internal statistics of business), or statistics applied to the exact sciences (agronomy, medicine, chemistry, physics, etc.).

VI. Taking into account the fundamental principles set forth in the paragraph above, we may consider the following outline of a possible program for the study of statistics, or of the various branches of statistics. Perhaps it will not be out of place to stress the idea that the underlying motive in all statistical instruction should be, not to have the students memorize formulas and methods, but rather to stimulate in them, from the lowest grade to the highest, the spirit of independent thinking, of interest in the result of their work, and of eagerness for scientific investigation, all of which things are essential for the attainment of worth-while results in any statistical undertaking.

The program in its general aspects may be presented as follows:

1. Primary grade: Elementary algebra and arithmetic (equations). Simple averages (arithmetical). Proportions (percentages). Elements of compilation, filing, and public administration. Simple questionnaires. The construction of simple tables. Simple graphs. Special fields: Economic statistics; social statistics; public health; commercial and industrial. The operation of calculating machines.

2. Intermediate grade: Advanced algebra and arithmetic (quadratics). More complicated equations (with two or more unknown quantities). Logarithms. Geometric averages. Link relatives. Median and mode. More complicated tables and graphs. Simple index numbers. Complex filing systems (decimal index). Logarithmic curves. Regressions. Graphs in popular form. Operation of calculating machines. The slide rule. More extensive specialization.

3. Advanced grade: Financial and actuarial mathematics (calculus). Calculation of probabilities. Complete statistical methodology (errors, sampling, derivations, correlations, adjustment of variations, indexes of all kinds). Final analysis. Interpolation and extrapolation. Complex indexes. Complex graphs. Special fields: Economic and social statistics;

statistics of public health and medicine; statistics of the exact sciences; demographic statistics; internal statistics of business establishments; analysis of markets. Operation of machines using punched cards.

During the whole program the students would be required to do practical work (laboratory work) in considerable quantity based on actual cases. Publications and other statistical material would be discussed, analyzed, and evaluated.

The program outlined above constitutes only a brief summary presentation, far from complete. It would be essential to take advantage of experience in various countries and especially of that in Colombia under Professor Emilio C. Guthardt.[2]

It would be desirable for the American countries to adopt a program as far as possible standardized, especially for the teaching of their statistical employees, and more than anything else, for them to use standard technical terms in teaching and in publications and statistical reports, not only in English, but in Spanish, Portuguese, and French, for the different concepts and operations of statistics.

The profession of statistician should be rather clearly defined, recognized, and given certain privileges. For appointment to certain public positions, qualification in statistics, whether first, second, or third grade, should constitute an absolute prerequisite.

It may be said without exaggeration that certain skills in the field of statistics are now much more important than those in the field of accounting. If, then, the latter stand so high in many countries of this continent, why might there not be established a similar set of standards for statistics? There is no thought in this of creating a new class of certified public statisticians, but there is no doubt about the absolute necessity in all countries of having an appreciable number of persons trained in statistics, not only in public administration but also in private business. There seems to be no other way of attaining this end except through a wide extension of the teaching of statistics, not only through institutes or independent courses, but also through the inclusion of statistics in the program of commercial colleges and secondary schools in general as a required subject.

[2] See his article "Organization and Results of an Official Course in Statistics by Correspondence," in *Estadística*, Vol. I, No. 1, page 132.

ON SAMPLES FROM FINITE POPULATIONS

By Jerome Cornfield
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THE FOLLOWING NOTE is designed to illustrate a little-known device that has been found useful in the derivation of expected values and variances of statistics estimated from samples drawn from finite populations without replacement. Its only advantage is that it reduces the manipulations, which at best are tedious, to a simple algebraic routine. Its use is illustrated below in the derivation of the expected value of the sample mean and the variance of that mean.

THE EXPECTED VALUE OF A SAMPLE MEAN

Consider a parent population composed of N elements, with the mean for characteristic X defined as

$$\overline{X} = \frac{1}{N} \sum_{i=1}^{N} X_i. \tag{1}$$

The subscript i is to be considered as denoting a particular element in the population, so that X_i denotes the value for the ith element of the characteristic X. Thus X_i is a constant and not a sampling variate. Now denote the sample mean by

$$\overline{X}' = \frac{1}{n} \sum_{i=1}^{N} a_i X_i. \tag{2}$$

a_i is a variate which can assume one of two values. Its value is assigned after the sample is drawn. For any sample,

$a_i = 1$ if the ith element is included in the sample.
$= 0$ otherwise.

Since a_i is a sampling variate, while X_i is constant over successive samplings,

$$E\overline{X}' = \frac{1}{n} \sum_{i=1}^{N} X_i E a_i, \tag{3}$$

where E stands for expected value. By definition,

$$Ea_i = \text{Zero times (Prob. } a_i = 0) + \text{One times (Prob. } a_i = 1) \tag{4}$$

$$= \text{(Prob. } a_i = 1). \tag{5}$$

The probability that a_i is equal to one is the ratio of two quantities—(A) the total number of samples which can be drawn in which

$a_i=1$ (that is, the total number of samples which include the ith element).

(B) the total number of samples which can be drawn. In these $a_i=1$ in some and 0 in others (that is, the total number of samples of size n which can be drawn whether or not they include the ith element).

The second quantity is obviously $\binom{N}{n}$. The first is seen to be $\binom{N-1}{n-1}$ by the following argument: We may enumerate all the samples of size n that include the ith element by

(a) removing it from the parent population, thus reducing its size to $N-1$

(b) drawing random samples of size $n-1$ without replacement from this reduced population

(c) adding the ith element to each sample so obtained.

The total number of different samples that can be obtained in step (b) is $\binom{N-1}{n-1}$, whereupon

$$(\text{Prob. } a_i = 1) = Ea_i = \binom{N-1}{n-1} \Big/ \binom{N}{n} = \frac{n}{N}. \tag{6}$$

Substituting in (3) we obtain

$$E\overline{X}' = \frac{1}{N}\sum_{i=1}^{N} X_i = \overline{X}, \tag{7}$$

indicating that the sample mean is always an unbiased estimate of the population mean, a fact which is, of course, well known.

THE VARIANCE OF THE SAMPLE MEAN

The variance of the sample mean is defined as $E(\overline{X}')^2-(E\overline{X}')^2$. It may be derived as follows:

$$\overline{X}' = \frac{1}{n}\sum_{i=1}^{N} a_i X_i \tag{8}$$

$$(\overline{X}')^2 = \frac{1}{n^2}\left[\sum_{i=1}^{N} a_i^2 X_i^2 + 2\sum_{i=1}^{N}\sum_{j=i+1}^{N} a_i a_j X_i X_j\right] \tag{9}$$

and

$$E(\overline{X}')^2 = \frac{1}{n^2}\left[\sum_{i=1}^{N} X_i^2 Ea_i^2 + 2\sum_{i=1}^{N}\sum_{j=i+1}^{N} X_i X_j Ea_i a_j\right] \tag{10}$$

$$Ea_i^r = Ea_i = n/N, \text{ for all } r > 0. \tag{11}$$

$Ea_i^r a_i^s$ $(i \neq f)$ may, by an argument similar to that used above, be shown to be equal to $\binom{N-2}{n-2}/\binom{N}{n}$ for all r and $s > 0$. In which case

$$Ea_i a_j = \frac{n}{N} \frac{n-1}{N-1}. \tag{12}$$

Equation (10) then gives

$$E(\overline{X}')^2 = \frac{1}{nN}\left[\sum_{i=1}^{N} X_i^2 + 2\frac{n-1}{N-1}\sum_{i<j} X_i X_j\right] \tag{13}$$

whereupon

$$E(\overline{X}')^2 - (E\overline{X}')^2 = \frac{1}{n}\frac{N-n}{N-1}\frac{\sum_{i=1}^{N} X_i^2 - N\overline{X}^2}{N}. \tag{14}$$

If we denote the variance of the parent population by σ^2, we have

$$E(\overline{X}')^2 - (E\overline{X}')^2 = \frac{\sigma^2}{n}\frac{N-n}{N-1}. \tag{15}$$

This result is also well known.

Simple extensions of the definition of the variate a_i make it possible to use it in considerably more complicated cases. Thus, in the case of sampling designs in which m clusters (counties, cities, blocks, etc.) are sampled from a population of M clusters, and n_i elements are sampled in the ith cluster from a population of N_i elements, we use one variate, a_{ij} which equals 1, when the jth element in the ith cluster is included in the sample, but is 0 otherwise; and another variate α_i which equals 1 when the ith cluster is included, but is 0 otherwise. In that case if

$$\overline{X} = \sum_{i=1}^{M}\sum_{j=1}^{N_i} X_{ij} \Big/ \sum_{i=1}^{M} N_i \tag{16}$$

and

$$\overline{X}' = \sum_{i=1}^{M} \alpha_i \frac{N_i}{n_i} \sum_{j=1}^{N_i} \alpha_{ij} X_{ij} \Big/ \sum_{i=1}^{M} \alpha_i N_i, \tag{17}$$

then the expected value and variance may be derived by noting that

$$Ea_{ij} = n_i/N_i \tag{18}$$

$$E\alpha_i = m/M \tag{19}$$

$$E\alpha_i a_{ij} = E\alpha_i E a_{ij} = \frac{m}{M}\,\frac{n_i}{N_i} \tag{20}$$

$$E\alpha_i\alpha_k = \frac{m}{M}\,\frac{m-1}{M-1}\,. \tag{21}$$

Equation (20) shows that when drawing m clusters from a population of M clusters, and then drawing n_i elements from the ith cluster (of size N_i), the probability of getting the jth element of the ith cluster in the sample is the product of two probabilities—viz., the probability of drawing the ith cluster and then independently drawing the jth element from it. Since the estimate $\overline{X}'$, defined by (17), is not in general an unbiased estimate of $\overline{X}$, as defined by (16), although in virtually all physical situations likely to be encountered in actual practice the bias will be negligible, the expected value and variance derived by use of equations (18)–(21) will be approximations rather than algebraic identities like (7) and (15).

A SIMPLIFIED FORMULA FOR MEAN DIFFERENCE

By Tseng-Tung Cheng
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Some statisticians[1] have advocated the use of the quantity called "mean difference" in place of the commonly used mean deviation or standard deviation as a measure of the tendency of the spreading of a set of statistical data. The formula for this quantity as given in statistical books is rather long and not amenable to routine computation. By using a simple formula from the calculus of finite differences, a new relation for the computation of the sum of the differences between any two values of a set of N items when the latter are grouped into class intervals having the same length is obtained. By definition, this sum divided by the number of pairs of items in the set is their mean difference.

Let n = number of class intervals into which the set of N items is grouped;
s = length of each class interval;
f_k = frequency in the kth interval;
x_k = mid-value of the kth interval;
$F_i = \sum_{k=1}^{i} f_k$ = sum of the number of items in the first i class-intervals;
N = total number of items in all the intervals = F_n;
m = mean difference;
$C_2^N = \frac{1}{2}N(N-1)$ = number of combination of N things taken two at a time.

Then by definition,

$$C_2^N \times m = \sum_{i=2}^{n} \sum_{j=1}^{i-1} (x_i - x_j) f_i f_j = \sum_{i=2}^{n} \sum_{j=1}^{i-1} (i-j) s f_i f_j. \qquad (1)$$

As is well-known in the calculus of finite differences,

$$\sum_{j=m}^{p} U_j V_j = U_{p+1} \sum_{j=m}^{p} V_j - \sum_{j=m}^{p} \Delta U_j \sum_{k=m}^{j} V_k, \qquad (2)$$

Editor's Note.—This and the following paper have come by devious routes to the Journal office. The Editor has found it very interesting to realize that, after seven long years of war, statisticians in China can still make worthy contributions to statistical methodology.

It is regretted that most details of the story are missing. The following quotation from a letter can but whet one's appetitite. "His University fled from the Coast at the approach of the Japanese, but only a couple hundred miles west to Chanting which, in common with most parts of China a few miles from railroads and waterways, has never been in Japanese hands—though it has been bombed by them."

[1] Bowley, *Elements of Statistics*, p. 114.

where ΔU_j denotes the first difference of U_j, i.e. $U_{j+1}-U_j$. Now taking $U_j=i-j$, $V_j=f_j$, we find $U_i=0$, $\Delta U_j=-1$, and

$$\sum_{j=1}^{i-1}(i-j)f_j = U_i\sum_{j=1}^{i-1}f_j - \sum_{j=1}^{i-1}\Delta U_j\sum_{k=1}^{j}f_k = \sum_{j=1}^{i-1}\sum_{k=1}^{j}f_k = \sum_{j=1}^{i-1}F_j. \tag{3}$$

By substitution, equation (1) becomes

$$C_2{}^N \times m = \sum_{i=2}^{n}\sum_{j=1}^{i-1}F_jf_is. \tag{4}$$

In (4), by interchanging the order of summation and remembering that the starting value for j is 1, that the final value for i is n, while i is greater than j by 1 at the least, we obtain

$$C_2{}^N \times m = \sum_{j=1}^{n-1}\sum_{i=j+1}^{n}f_iF_js = \sum_{j=1}^{n-1}(F_n - F_j)F_js$$

$$= \left(N\sum_{j=1}^{n-1}F_j - \sum_{j=1}^{n-1}F_j{}^2\right)s, \tag{5}$$

whence

$$\text{the mean difference, } m = \frac{\left[N\sum_{j=1}^{n-1}F_j - \sum_{j=1}^{n-1}F_j{}^2\right]s}{C_2{}^N}. \tag{6}$$

It should be pointed out that the quantity M^2 defined below as the mean of the squares of the differences between any two values of a set of N items bears a definite relation to the standard deviation of these N items as mentioned by Bowley.[2] This is readily shown algebraically as follows. Let

M^2 denote the mean square difference;
X_i and X_j, any two values in the set;
A, the arithmetic average; and
N, the total number of items in the set.

Then by definition

$$M^2 = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N}(X_i - X_j)^2}{N(N-1)} = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N}(X_i - A + A - X_j)^2}{N(N-1)}$$

$$= \frac{2N\sum_{i=1}^{N}(X_i - A)^2}{N(N-1)}. \tag{7}$$

[2] *Loc. cit.*, p. 115.

Now the standard deviation σ is defined by $N\sigma^2=\sum_{i=1}^{N}(X_i-A)^2$, and so

$$M^2 = 2N\sigma^2/(N-1), \quad \text{or} \quad M = \sqrt{2N/(N-1)}\sigma. \tag{8}$$

On account of this relation it appears that whatever merit the quantity m called mean difference may possess is equally shared by the standard deviation σ or its analogue, the root mean square difference M.

In concluding the writer wishes to express his gratitude to President A.P.-T. Sah of the National Amoy University for valuable suggestions.

A NEW PROBABILITY FUNCTION AND ITS PROPERTIES

By Tseng-Tung Cheng
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Let $x_1, x_2, \cdots, x_n$ be n quantities which vary within the interval $(0, 1)$ and have the same probability function $\phi(x)$. Let $f(t)dt$ be the probability that the sum of these n quantities has a value between t and $t+dt$. Then

$$f(t) = \frac{d}{dt}\int\int \cdots \int_V \phi(x_1)\phi(x_2)\cdots\phi(x_n)dx_1dx_2\cdots dx_n, \qquad (1)$$

where the region V, over which the n-tuple integral is extended, is defined by the inequalities

$$0 \leqq x_1 \leqq 1,\ 0 \leqq x_2 \leqq 1, \cdots, 0 \leqq x_n \leqq 1,\ x_1+x_2+\cdots+x_n \leqq t. \qquad (2)$$

Let V' be the region defined by

$$0 \leqq x_1,\ 0 \leqq x_2, \cdots, 0 \leqq x_n,\ x_1 + x_2 + \cdots + x_n \leqq t,$$

and V_s be that part of V' in which s and only s of the x's are greater than 1, so that when $k<t\leqq k+1$, we may write symbolically

$$V' = V + V_1 + \cdots + V_k. \qquad (3)$$

Again, let $V^{(s)}$ be the region defined by

$$x_1 \geqq 1, \cdots, x_s \geqq 1,\ x_{s+1} \geqq 0, \cdots, x_n \geqq 0,\ x_1+x_2+\cdots+x_n \leqq t \qquad (4)$$

where, of course, s is less than t. Furthermore, we will denote the values of the n-tuple integral

$$\int\int \cdots \int \phi(x_1)\phi(x_2)\cdots\phi(x_n)dx_1dx_2\cdots dx_n$$

extended over the regions V, V', V_s and $V^{(s)}$ respectively[1] by I, I', I_s and $I^{(s)}$.

By the definitions given above, we may derive the following relations:

$$\left.\begin{aligned}
C_1^n I^{(1)} &= I_1 + C_1^2 I_2 + C_1^3 I_3 + \cdots + C_1^k I_k \\
C_2^n I^{(2)} &= I_2 + C_2^3 I_3 + \cdots + C_2^k I_k \\
C_3^n I^{(3)} &= I_3 + \cdots + C_3^k I_k \\
&\vdots \\
C_k^n I^{(k)} &= I_k
\end{aligned}\right\} \qquad (5)$$

[1] It is assumed here that the function $\phi(x)$ has also been defined for values of x lying outside the interval $(0, 1)$.

where C_s^n denotes, as usual, the number of combinations of n things taken s at a time.

With the aid of the relation

$$I' = I + I_1 + \cdots + I_k,$$

which follows immediately from equation (3), we find from equations (5) that

$$I = I' - C_1^n I^{(1)} + C_2^n I^{(2)} - \cdots + (-1)^k C_k^n I^{(k)}. \tag{6}$$

The transformation

$$x_1 = z_1 + 1, \cdots, x_s = z_s + 1, x_{s+1} = z_{s+1}, \cdots, x_n = z_n \tag{7}$$

carries the region $V^{(s)}$ into a new region $R^{(s)}$ defined by the inequalities

$$z_1 \geqq 0, z_2 \geqq 0, \cdots, z_n \geqq 0, z_1 + z_2 + \cdots + z_n \leqq t - s. \tag{8}$$

Hence

$$I^{(s)} = \iint \cdots \int_{R^{(s)}} \phi(z_1 + 1) \cdots \phi(z_s + 1)\phi(z_{s+1}) \cdots \phi(z_n)dz_1dz_2 \cdots dz_n. \tag{9}$$

If $\phi(x)$ be a polynomial in x, then each of the integrals I' and $I^{(s)}$ is the sum of a number of Dirichlet's integrals, and may therefore be expressed in terms of Γ functions. In particular, when $\phi(x) \equiv 1$,

$$I' = \frac{[\Gamma(1)]^n}{\Gamma(n+1)} t^n = \frac{1}{n!} t^n, \tag{10}$$

$$I^{(s)} = \frac{1}{n!} (t - s)^n, \quad s = 1, 2, \cdots, k. \tag{11}$$

Substituting (10) and (11) into (6) gives

$$I = \frac{1}{n!} [t^n - C_1^n(t-1)^n + \cdots + (-1)^k C_k^n (t-k)^n], \quad k < t \leqq k+1. \tag{12}$$

Differentiating (12) we obtain finally

$$f(t) = \frac{dI}{dt} = \frac{1}{(n-1)!} [t^{n-1} - C_1^n(t-1)^{n-1} + \cdots + (-1)^k C_k^n (t-k)^{n-1}], \quad k < t \leqq k+1. \tag{13}$$

As shown elsewhere,[2] the function $f(t)$ has the following properties:

[2] T. T. Cheng, Collected Scientific and Engineering Papers, National Amoy University.

(a) $f(t)$, together with its first $n-2$ derivatives, is continuous throughout the interval $(0, n)$.

(b) $f(t)$ is symmetric with respect to the point $t=\frac{1}{2}n$.

(c) $f(t)$ increases in the t-interval $(0, \frac{1}{2}n)$ and decreases in $(\frac{1}{2}n, n)$.

(d) The moments of $f(t)$ with respect to its arithmetic average $t=\frac{1}{2}n$ are given by the following identity:

$$\sum_{k=0}^{\infty} \frac{t^k}{k!}\mu_k = \left(\frac{e^t - 1}{te^{\frac{1}{2}t}}\right)^n, \tag{14}$$

where μ_k denotes the kth moment. Hence

$$\mu_0 = 1,\ \mu_1 = 0,\ \mu_2 = n/12,\ \mu_3 = 0,\ \mu_4 = (5n^2 - 2n)/240, \cdots . \tag{15}$$

In general, $\mu_{2k+1}=0$ and μ_{2k} is a polynomial of the kth degree in n which may be written in the form

$$\mu_{2k} = \frac{(2k!)}{k!}\left[\frac{1}{3!}\,\frac{1}{2^2}\right]^k n^k[1 + \text{terms involving } 1/n]. \tag{16}$$

Neglecting the terms involving $1/n$ and denoting the standard deviation by σ, this equation gives

$$\sigma^2 = \mu_2 = n/12, \tag{17}$$

whereupon it follows that

$$\mu_{2k} = (2k - 1)(2k - 3) \cdots 3.1\sigma^{2k}, \tag{18}$$

which is a property characteristic of the normal curve

$$y = \frac{1}{\sqrt{2\pi}\,\sigma}\, e^{-x^2/2\sigma^2}.$$

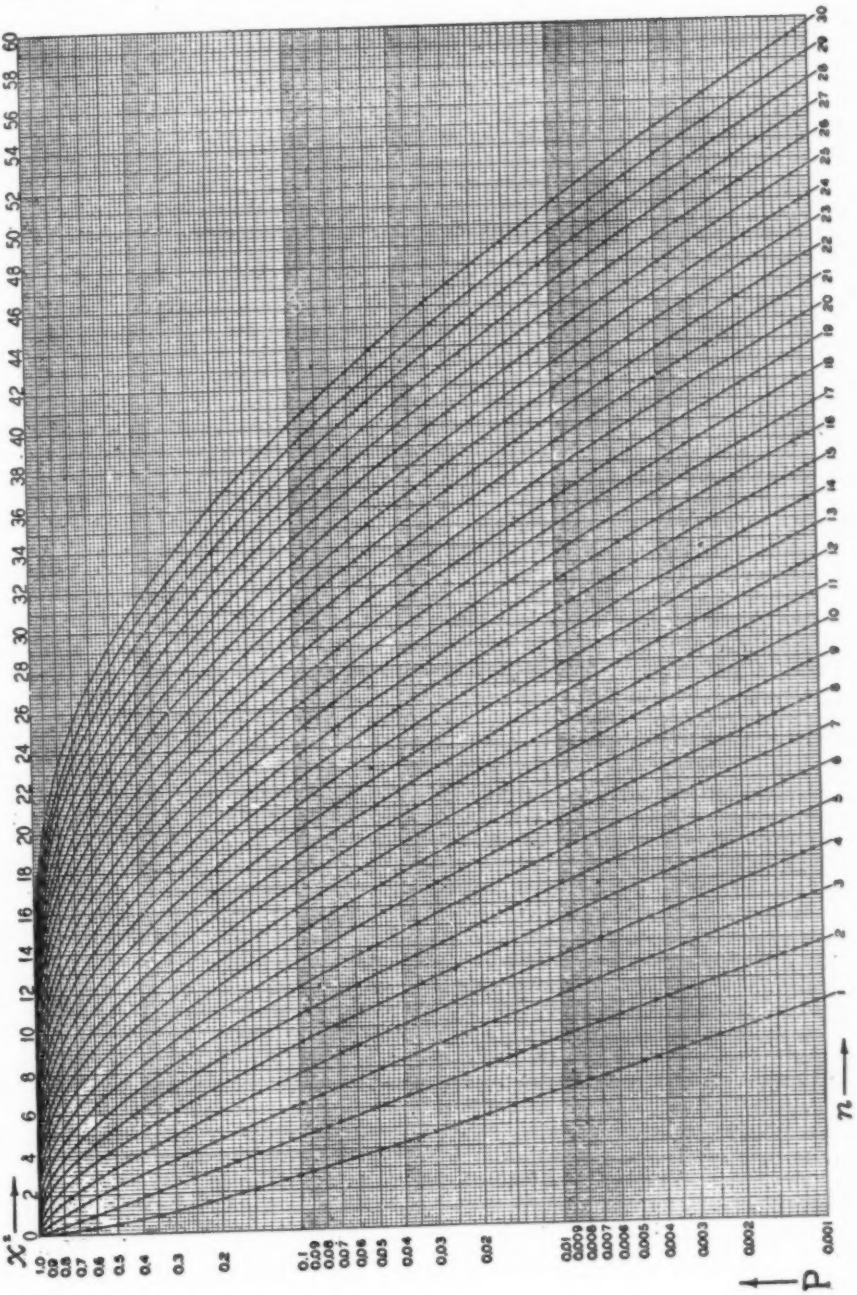
A CHART OF THE CHI-SQUARE DISTRIBUTION

By C. I. Bliss
Yale University and Connecticut Agricultural Experiment Station

In reaching conclusions from data, the information provided by chi-square is often the most decisive single factor. Other information, however, may determine in any particular case the level of probability which the experimenter will accept as "significant," despite the general adoption of $P=0.05$ as its numerical equivalent. Reporting the value of P corresponding to a given chi-square would facilitate the interpretation of a result. Most tables of the chi-square distribution require inverse interpolation of a non-linear function to obtain the value of P, which discourages its being reported more exactly. Alternatively, the distribution can be plotted on semi-logarithmic paper in a form allowing easy graphic interpolation of the probability. Since degrees of freedom (n) are discontinuous, a separate curve is drawn for each in the usual range from $n=1$ to 30 giving continuous functions for χ^2 and P on the abscissa and ordinate respectively.

Such a chart for probabilities from $P=0.01$ to 1.0 was prepared by the author in 1927 and photographed for use in laboratories of the Bureau of Entomology of the U. S. Department of Agriculture. It has since proved so valuable a time-saver in interpreting chi-square that the diagram has recently been redrawn to cover a wider range of probabilities, from $P=0.001$ to 1.0. For this purpose points were plotted from three tables of chi-square, Table XII in Pearson's *Tables for Statisticians and Biometricians*, Part I (1924); Table IV in Fisher and Yates' *Statistical Tables for Biological, Agricultural and Medical Research* (1938) and the "Table of Percentage Points of the Chi-Square Distribution" by K. M. Thompson, *Biometrika*, 32: 187–191 (1941). Smooth curves were drawn through these points with an adjustable ruler, leading to the chart shown in reduced form in the accompanying figure. Values of P in the useful range can be interpolated from the original chart with an error not exceeding one or two digits in the second significant figure. Limited numbers of the full-size chart may be obtained without charge on application to the Department of Pharmacology of Yale University.

The use of the chart may be illustrated by an experiment in bioassay. Three digitalis-like drugs, isolated from two species of *Calotropis*, have been compared in parallel titration-tests with ouabain and with each


χ²
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.09 0.08 0.07 0.06 0.05 0.04 0.03 0.02 0.01 0.009 0.008 0.007 0.006 0.005 0.004 0.003 0.002 0.001
P
n
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

other for their toxicity to cats (*J. Pharm. and Exptl. Ther.* 74, 223–234, 1942). Since the logarithms of the lethal doses are usually distributed normally, the drugs have been compared in terms of their geometric means as measures of the median lethal dose (LD50). Differences in size of cat were adjusted by dividing the fatal dose of drug per cat by the 2/3 power of its heart weight. Whether the doses killing 50 per cent of the cats were reliable indices of relative toxicity at lower or higher mortalities, such as 5 or 95 per cent, depends upon the equivalence in logarithmic units of the standard deviations of the four drugs.

In order of increasing LD50, the estimated standard deviations with 11 degrees of freedom were 0.0714, 0.0629, 0.1319 and 0.0842 for ouabain, calotropin, calotoxin and uscharin, respectively. Whether these were consistent with their pooled value of $s=0.0916$ ($n=44$) has been examined by Bartlett's χ^2 test for the homogeneity of a series of variances (*J. Roy. Stat. Soc. Suppl.* 4, 137–170, 1937). The result was $\chi^2=7.28$ with 3 degrees of freedom (n). Referring to the curve for $n=3$ in the accompanying chart, we find that $P=0.063$ at $\chi^2=7.28$. The odds were 63 in 1000 that the differences observed in the standard deviation could have arisen by chance alone if the four drugs were characterized by the same standard deviation. Recomputing with ouabain omitted, $\chi^2=5.89$ from which the curve for $n=2$ gives $P=0.052$. This is just at the border line of significance and suggests that the three drugs from *Calotropis* may differ qualitatively in their action, in which case they would have different relative toxicities at doses killing 5 and 95 per cent.

Acknowledgment: I am indebted to my assistant, B. L. Bartels, for preparing the original of the present chart.

NOTES AND DISCUSSIONS

HENRY LEWIS RIETZ, 1875–1943

PROFESSOR HENRY LEWIS RIETZ, distinguished mathematician, statistician and actuary, died December 7, 1943, at 12:25 A.M. at University Hospital in Iowa City, Iowa, after a two year illness.

Professor Rietz was born in Gilmore, Ohio, August 24, 1875, the son of Jacob and Tabitha Jane Rietz. He received his B.S. degree from Ohio State University in 1899. During 1900–01 he was a Fellow at Cornell University. He was Assistant in mathematics at Cornell during 1901–02 and received the degree, Ph.D., from Cornell in 1902.

Professor Rietz was Professor of Mathematics and Astronomy at Butler during 1902–03; Instructor in Mathematics, 1903–04, Assistant Professor of Mathematics, 1904–11, Associate Professor of Mathematics, 1911–13, and Professor of Mathematics, 1913–18, at the University of Illinois. He came to the University of Iowa in 1918 as Professor of Mathematics and Head of the Department of Mathematics. Under his leadership, the department became an outstanding school in the fields of Statistics and Actuarial Theory. Many of his students hold prominent positions in the statistical and actuarial world. He continued to serve as department head with outstanding success until his retirement from the position in September, 1943. He was in charge of the Statistical Experiment Station, University of Illinois, 1907–18. In 1916 and in 1918, he served as a member and consulting actuary for the Illinois Pension Laws Commission. He was actuarial consultant, Federal Emergency Relief Administration, in 1934–35. He served as a Trustee of the Teachers Insurance and Annuity Association in 1934.

Professor Rietz was a Fellow of the American Association for the Advancement of Science (vice-president in 1929), a member of the American Mathematical Society (vice-president in 1930), Associate Editor of *Bulletin of the American Mathematical Society*. He was a member of the Mathematical Association of America (president in 1934), a Fellow of Institute of Actuaries (vice-president in 1919), a member of the American Statistical Association (vice-president in 1925), a Fellow of the Institute of Mathematical Statistics (president in 1935–37), a member of the Iowa Academy of Sciences (president in 1930), a Fellow of the Royal Statistical Society, and Associate Editor of the *Transactions of the American Mathematical Society* in 1937.

He was a member of A.T.O. social fraternity, Sigma Xi honorary scientific fraternity, Phi Beta Kappa national scholastic society and Gamma Alpha honorary graduate scientific fraternity.

Professor Rietz was the founder of the Institute of Mathematical Statistics. In March, 1943, the Board of Directors of the Institute dedicated the 1943 volume of its official *Annals* to him on the occasion of his retirement after twenty-five years of service and "in recognition of his contributions to the initiation and development of mathematical statistics in America." This was the first time the official *Annals* has been so dedicated.

He was the principal author of college text books in Algebra, Trigonometry, and Mathematics of Finance. He was the principal author and Editor-in-Chief of the *Handbook of Mathematical Statistics* and was the author of *Mathematical Statistics* (Carus Monograph #3). In addition, he has published at least 150 significant articles in mathematics, statistics and actuarial theory in various journals.

In 1939, the Iowa Mathematical Alumni Association had a portrait of Professor Rietz made and presented it to the University in the spring of 1940. This portrait has been placed in the Mathematics and Physics library in the Physics Building. The Alumni also presented him with a watch in appreciation of the training they received from him.

Professor Rietz was very active in local affairs: he was a member of the official board and chairman of the finance committee of the Methodist Church for more than 20 years. For more than 15 years he was chairman of the finance committee of the Iowa City Country Club and was its President for two years. In June 1919, he became a charter member of the Iowa City Building and Loan Association and has been President since June 1920. He was a member of the Board of Directors of the First Capitol State Bank and a member and former President of the Kiwanis Club.

Surviving him are a brother, Professor John Rietz, Morgantown, West Virginia, and a sister, Mrs. F. S. Taylor, Caldwell, New Jersey.

Professor Rietz was a Christian gentleman, a great scholar and researcher, and an excellent teacher. He was the concrete expression of honesty and had a frankness that was both most pleasing and refreshing. He had a keen intellect, an alert analytical mind and was a man with whom honor was sacred. Because of his character and ability, his advice and judgment were much sought when, and only when, a cause was honest and just. He loved the game of golf for recreation. He was an excellent companion and had a sense of humor that made him many friends who are scattered far and wide throughout the country. All his friends delighted in his companionship. He was very generous and never failed in his efforts to advance deserving friends, students, and associates and he was very devoted to his friends and relatives.

He enjoyed life and lived a full life whether it was doing serious work or during times of relaxation. He was in every sense the ideal one would seek in research and teaching. He considered research essential in teaching, but it was teaching itself that gave him the most pleasure. He was the kind of man which makes any university great.

I have known Professor Rietz for 25 years. I have known him as a colleague, a department head, a teacher, and a companion. He was much closer than a true friend and companion to me. He was my best friend and my best teacher. We have all lost a great scholar, a great teacher and man.

Frank Mark Weida

ARNE FISHER, 1887–1944

Arne fisher—Mathematician and Philosopher—passed away April 7, 1944, at the relatively young age of fifty-seven. A scholar in every sense of the word, Fisher's comments on any subject were always enlightening, significant and, salted with a humorous touch peculiarly his own, most entertaining.

Regarding Fisher's contributions in the field of statistics and probability theory, work on war problems prevents the writer from devoting to them the time required for an adequate discussion. Moreover, an intimate friendship of over a quarter of a century makes it difficult for him to take, at this time, a detached attitude toward Fisher's work. However, in anticipation of a later review either by himself or by some more competent person, it may be stated here that Fisher's greatest contribution was calling to the attention of American mathematicians the works of the great Scandinavian statisticians. Gram, Thiele, Westergaard, Charlier, were mere names to us before the publication of Fisher's *The Mathematical Theory of Probabilities* in 1922.

Arne Fisher was born in Randers, Denmark, and came to the United States in 1902. At the time of his death he had been for twenty-four years actuary of the Western Union Telegraph Company, where his work was chiefly concerned with business forecasting and with the Company's employe pension plan. Before joining the Telegraph Company he had been with the Prudential Insurance Company. He was a Fellow of the American Statistical Association and of the Association of Swiss Actuaries and a member of the Royal Danish Actuarial Society.

Edward C. Molina

A REPLY TO W. EDWARDS DEMING'S REVIEW OF *TREATMENT OF EXPERIMENTAL DATA*

BY A. G. WORTHING
University of Pittsburgh

A BOOK REVIEWER has a responsibility both to the author and to the reading public, particularly that public, normally indicated in the preface, for which the book is intended. Many reviews, as Mr. Deming has said, are "written by some one who sits down and hands out bouquets without cracking the book" or at least approximately that. Such reviews are practically useless.

The question arises, what should a review include? Without doubt others will differ with the writer, but in his opinion, certain principles will be conceded generally. In addition to the normal introductory matter, a book review should indicate, (1) except where obvious, the fields covered in a somewhat, but not too, detailed way, (2) the public for whom the book is intended, (3) criticisms, favorable and unfavorable, of the need of the book, of procedures followed, of material included or left out, of the precision or lack of precision encountered, of the English used, and of such other material as will enable a busy potential user to conclude that the book is probably worth or not worth his while. The public for whom the book is intended should be continually kept in mind. It is perfectly proper for a reviewer to "pan" an author for lack of purpose, faulty procedures, looseness of thought, failure to include appropriate material, failure to exclude inappropriate material and many other things. Such panning should be done justly, however, for the author ordinarily has but little opportunity for a comeback.

In addition to a few commendatory remarks, your reviewer[1] of *Treatment of Experimental Data*[2] has properly called attention to certain failures to include appropriate matter, has pointed out certain inaccuracies of statement, has listed certain original authors that were not mentioned, and has indicated that certain procedures which the authors have followed are unsatisfactory. These criticisms we appreciate and shall make use of them in case the public for whom the book is intended find the book so useful that a revision is justified. However, there are certain criticisms to which we make objection on the basis that they do not conform to the principles which we believe should govern the writing of a book review. Certain of these I discuss here.

The reviewer has not indicated the public for whom the book is in-

[1] This JOURNAL, March 1944, pp. 119–122.

[2] *Treatment of Experimental Data*, by A. G. Worthing and Joseph Geffner, 1943, John Wiley and Sons, Inc., New York.

tended, though the authors state in the preface, "This book has been written with the physicist, the chemist and the engineer in mind . . . considerable effort has been made to keep physical situations in mind throughout." Moreover, reading between the lines, it seems to the writer that the reviewer really reviewed from the standpoint of highly trained mathematicians rather than from the standpoint of those who are moderately trained in mathematics. Definitely our public was the latter group.

In discussing the section entitled "change of weights implied by a change of variables," Dr. Deming built up the impression that the authors were muddled regarding the effects of such changes of variables on the least-squares determinations of constants. He quotes one sentence from the section which by itself gives the impression that there are several least-squares determinations for a given constant. However, taken with the material which follows immediately that impression is shown to be wrong. Of course, the authors should have added the introductory phrase, "Disregarding weights." The ideal of making each sentence stand by itself is fine. I like it, but, I fear, I fail in living up to it. Incidentally, it is about as heinous to hold up, as expressive of an author's views, a single sentence which apparently differs from its context. Further, the very title to the section under discussion, as quoted above, shows that the authors were not muddled. Incidentally with regard to the alleged failure to take our own advice on page 248, I am of the opinion that the judgment given was too hasty. What we said may be badly worded, but it seems to be correct.

We cannot follow the reviewer in his criticism of the section relating to "The least-squares Equation of the Type $y=a+bx$ when Liability of errors occurs with both x and y." We say "Since x and y will generally differ in physical nature, it is necessary to treat certain simple functions of these variables rather than x and y themselves. These functions must be either dimensionless or expressible in the same physical units. Otherwise there seems to be no logical way of properly weighting them." As a physicist who thinks of x and y as representing *physical quantities* and not *numbers*, I feel that the procedure is justifiable and that no other *fundamentally different* procedure is possible. Moreover, we have not indicated nor felt that "There is no way out in more complicated situations." As to procedure here, which is thought not to be straightforward, the reference to an imaginary plot showing $Y'=f(x')$, would possibly not appeal to a true mathematician, but I must say that it helps greatly with the people for whom we write.

The reviewer says, "The greatest fault is lack of purpose. Why does

one wish to fit a curve in the first place? What is he going to do with it when he gets through? Why does one adjust the angles of a triangle? What is the purpose of adjustment? Why does one take data? Why does one wish to present data? As a guide in framing a course of action, of course, or for predicting the result of a future experiment, but one can search the book in vain for the answer." I think that physicists, chemists, and engineers would all have answered these questions for themselves long before they would open the book. However, we seem actually to have very definitely answered the first four questions asked in the introductions to the various chapters. Although the fifth and sixth questions have not been answered directly, it seems as though the reviewer might have seen, as a purpose throughout, a desire to give to certain groups of scientific workers satisfactory methods for treating their data so that such data may be presented in good form and so that they themselves and those to whom their conclusions may be presented may know to some extent their reliabilities. While this may not seem like the predicting of the result of a future experiment, it is not far from giving thought to the framing of a course of action.

NOTE TO "A MECHANICAL DETERMINATION OF CORRELATION COEFFICIENTS AND STANDARD DEVIATIONS"*

The author's attention has been called to the omission from the above article of mention of the paper by Bronson Price, in *Science*, November 22, 1935, Vol. 82, No. 2134, pp. 497–8. This paper discusses the theoretical possibility of constructing a device almost identical in principle but somewhat different in design from the one actually used by the author.

JOHN R. PLATT

Physics Department,
Northwestern University

* This JOURNAL, September 1943, Vol. 38, pp. 311–318.

BOOK REVIEWS

GLENN E. MCLAUGHLIN, *Review Editor*

Estimates of Future Population of the United States, 1940–2000, by Warren S. Thompson and P. K. Whelpton. National Resources Planning Board. Washington: U. S. Government Printing Office. 1943. 137 pp. 35 cents.

This set of estimates of the future population of the United States is the third which W. S. Thompson and P. K. Whelpton, of the Scripps Foundation for Research in Population Problems, have prepared for the late National Resources Planning Board. In 1934 *Estimates of Future Populations by States* appeared; in 1937, *Population Statistics, 1, National Data*, some materials from which were included in *The Problems of a Changing Population* (1938). New circumstances made desirable a revision of the 1937 estimates.

> Quite apart from the war, certain changes have been taking place to alter the outlook for population in the United States. Among the new factors that are affecting the future size and composition of the population are the continuance through 1942 of the upward turn of the birth rate that began in the middle 1930's, the introduction of the new chemotherapy with its promise of further reduction in mortality, the relatively favorable course of Negro mortality in recent years, the progressively greater concentration of childbearing in the earlier years of marriage, and considerable advances in the science of nutrition (p. 3).

The new estimates, twelve in number, are more comprehensive than those published for other countries. The several estimates are based, as were those in the 1937 study, on varying assumptions and combinations of assumptions regarding future mortality, fertility, and immigration. These estimates do not allow for the prospective effects (military deaths, fewer births) of war; but estimated probable deductions attributable to the present war are separately classified and tabulated for years for which population estimates are reported. The population estimates, by sex and five year age groups, are given at five year intervals, 1940–2000, for native whites, foreign-born whites, and colored. Corrected and uncorrected figures are given for children under five years of age.

The new estimates run considerably higher than those reported by the authors in 1937, and they carry the population maxima farther into the future. For example, the new high fertility estimate, conjoined with medium mortality and no immigration, yields 174.4 million for 1980 in contrast with 167.9 million in the 1937 estimate; it yields 190.7 million for 2000 at which time the population, on these assumptions, will still be growing. The corresponding medium fertility estimate yields 160.9 million in 1980 in place of the 1937 estimate of 153; it gives a population maximum of 161.4 as of 1985. The corresponding low fertility estimate as of 1980 is 148.7 in place of the earlier 134; it yields a maximum of 150.5 as of 1970 in place of the former lower maximum as of 1960.

This new study contains much invaluable material. Applied population study cannot be carried on without such estimates. It is to be hoped that these estimates will be revised if and when circumstances make such revision desirable, and that provision will be made for the publication of such revised estimates.

JOSEPH J. SPENGLER

Duke University

The American-Born in Canada, by R. H. Coats and M. C. Maclean. Toronto: The Ryerson Press, New Haven: Yale University Press; London: Humphrey Milford: Oxford University Press. 1943. xviii, 176 pp. $3.75.

The Canadian-Born in the United States, by Leon E. Truesdell. Toronto: The Ryerson Press; New Haven: Yale University Press; London: Humphrey Milford: Oxford University Press. 1943. xvi, 263 pp. $3.00.

For at least a hundred years there has been a substantial interchange of population between Canada and the United States. The movement from Canada to the United States has been larger absolutely than the movement in the other direction and has been strikingly large relative to the Canadian population. During the 'eighties, for every thousand added to the native-born population of Canada, 717 Canadians were added to the population of the United States. In 1930 there were 1,286,389 Canadian-born resident in the United States, while in 1931 there were 344,574 American-born resident in Canada.

These volumes, which form part of the series on the relations of Canada and the United States sponsored by the Carnegie Endowment for International Peace, undertake to describe the characteristics of these two population-groups as fully as the census statistics of the two countries permit. The chapter headings follow traditional census classifications: age, sex, rural or urban residence, conjugal condition, racial origin, occupation and the like. The presentation is designed for those who can live on a diet of statistical detail. The tabulations, of which there are almost 200 in the two volumes, carry the burden of the story, and the text merely re-states and underlines salient features of the tables. The volumes will clearly remain as the definitive compilations of statistical material on the subject for the years preceding 1931. Data from the most recent Canadian and United States censuses were apparently not yet available when the manuscripts went to press.

This is not the sort of study which lends itself readily to summarization, since its essence is detail. As one would perhaps expect, the Canadian-born in the United States show an occupational distribution very similar to that of the total population and are in most other respects closely similar to the native-born. The American-born population of Canada is also in most respects highly similar to the native-born population; its occupational distribution deviates little from that of the total population except for a somewhat greater concentration in agriculture and in managerial occupations and a

lower concentration in common labor. Thus from an occupational standpoint the interchange of population shows no marked pattern. Both groups have proven highly assimilable, have acquired citizenship in their chosen country relatively quickly, and have intermarried freely with the native-born population.

An interesting contrast appears in the geographical distribution of the two groups within the country of immigration. The American-born are found in every county of Canada and show a more even distribution relative to the total population than almost any other immigrant group. The Canadians in the United States, on the other hand, show a marked tendency to *bloc* in a limited number of areas. Three states—Massachusetts, New York and Michigan—contain half the Canadian-born, and the tendency toward geographic concentration extends downward to individual cities and even individual wards of cities. Canadians have tended to go where other Canadians have preceded them, while the movement of Americans has been markedly individualistic.

Dr. Coats, in an ingenious and brilliantly-written essay which forms Part I of his volume, has attempted to find reasons for the remarkably even diffusion of the American-born throughout Canada. He finds the explanation mainly in the relatively long period of time during which the American-born of 1931 had resided in Canada, the variety of racial strains among American-born immigrants and the tendency of each to seek out its like in Canada, and the substantial backflow to Canada of children born to Canadians resident in the United States. He is careful to point out, however, that each of these "causes" is actually a combination of several causes which need to be distinguished and some of which work in opposite directions.

Lloyd G. Reynolds

Johns Hopkins University

Canada's Jews, A Social and Economic Study of the Jews in Canada, by Louis Rosenberg. Montreal: Canadian Jewish Congress, Bureau of Social and Economic Research. 1939. xxix, 418 pp.

There is hardly in the English-speaking world a study comparable to this comprehensive investigation of Rosenberg's on Canada's Jews. Everyone who is interested in population studies in general and in studies of the Jewish minority in particular will appreciate this careful and detailed research. The reason—apart from the author's own interest—that such a study was possible in Canada, is the fact that in the population statistics of this Dominion the item of religious affiliation is officially covered in the census questionnaire. This is not the case in Great Britain nor in the United States. Therefore in both the latter countries the reported number of living Jews and all further subdivisions by age, sex, place of birth, civil status, occupation, etc., will always depend on estimates or sample studies more or less reliable for the total.

The last enumeration of the Jews in Canada, census of 1931, yielded a number of 156,726; the author's estimate for 1936 was 166,710. This means an increase of more than 900 per cent over the corresponding population in 1901, of 16,131, or within a period of 35 years the Jewish population of Canada has multiplied ten times. This percentage increase, according to the author, is higher than in any other country with a Jewish minority, even in Palestine and Argentine. A great wealth of differentiated tables is given in the text and the statistical appendix, showing the distribution of the Jews throughout the country by provinces and larger cities, the rural and urban distribution by size of places, the age and sex distribution, conjugal condition, and many more items, mostly in comparison with other ethnic groups of the Canadian population. The occupational and economic structure of the Jews has been dealt with in great detail, by social position and by economic divisions and subdivisions (agriculture, industry, trade, free professions, domestic service, etc.). Some comparisons are added for Jewish minorities in other countries, quoted mostly after Arthur Ruppin's work, *The Jews in the Modern World.*

The figures for Canada worked out meticulously by Rosenberg speak their own language even if one does not always follow the conclusions of the author which, however, are mostly objective and non-polemic in the much discussed problem of occupational "abnormalities" of the Jews. The population movement, natality and mortality statistics for the years, 1926–36, comparative immigration of different ethnic groups to Canada and Jewish immigration in particular, since the turn of the century, are covered by a series of chapters and tabulations. It may be worth mentioning that for the Jews the sex ratio at birth exceeded significantly this ratio for the total Canadian population; 1230 Jewish boys were born to 1000 Jewish girls, in the average of 1926–36, as compared to the sex ratio of 1055 for the total population of Canada. Causes of death are not covered in Rosenberg's study, and therefore a comparison with the total population is not yet possible. But the exact population figures by age and sex, and even by occupation among the gainfully occupied persons, offer an excellent basis for further socio-biological and socio-pathological studies. Detailed statistics are further given on intermarriage among persons of different religious faith, on education, criminality, and some morbidity features (deafmutism, blindness, insanity). It is impossible here to go into more details of the invaluable source material which comprises 273 tables in text and annex. It may serve as an example of what can be achieved when census results are available concerning the Jewish faith as well as other religious denominations.

In a concluding chapter the author enters the question of anti-Semitism which already was occasionally touched upon in the preceding chapters. This question, of course, involving religious and racial prejudice cannot be exhausted by statistical evaluations only. Many imponderabilia and many other items come in, psychological, historical, political elements, and last but not least religious-ritual customs which in the case of the Jews, owing to

marriage laws, have led to greater inbreeding than in any other racial group. All this can hardly be appraised by statistics alone, and nothing is changed by substituting the term "ethnic" groups for "racial" groups as the author suggests. Yet a source work like that of Rosenberg's is the best and most reliable fundament for further discussions and should be emulated in other countries to clear the situation. Better knowledge of the basic facts will never produce—nor prevent—anti-Semitism which is essentially an emotional phenomenon not conquerable by logic and reason.

The only comparable source material that exists as far as this reviewer knows, is the equally monumental work of Heinrich Silbergleit (the late statistician and erstwhile director of the Statistical Bureau of the city of Berlin, prior to Hitler's rise to power): *Die Bevölkerungs- und Berufsverhältnisse der Juden im Deutschen Reich*, Berlin, Akademie-Verlag, 1930. Unfortunately, this source work in the German language has not been quoted by the author or listed in his bibliography, the only technical criticism worth mentioning.

George Wolff

Glen Echo, Maryland

Handbook of Tabular Presentation, by Ray Ovid Hall. New York: The Ronald Press Company. 1943. viii, 112 pp. $3.50.

For many years there has been an outstanding need for an adequate handbook of tabular presentation. Dr. Hall's book is in the first place too short for adequate coverage of the field, with only 13 pages of general text and 25 or 30 more devoted to the discussion of specific examples. In other respects, too, it falls short of meeting the current need—or the expectations aroused by its title page. It contains rather frequent recommendations of procedures that run counter to current usage. For example, Dr. Hall recommends the use of a parallel line at the bottom of the box head of the table, whereas current usage calls either for a parallel line at the top or for no parallel line at all. Again, he recommends that a title number should be separated from the title immediately following by a colon, whereas the almost universal practice is to use a period and a dash.

In a number of instances the author is apparently under a misapprehension on points of fact, as for example, in the statement that the table titles in the *Statistical Abstract* are printed in caps, whereas in recent issues of the Abstract the titles are printed entirely in caps and small caps, and even in the older issues the titles were only partly in caps. He insists or implies that every table should have a headnote, whereas it will be generally agreed that, with a few exceptions based on the nature of the material rather than on the form of the table, a good statistical table should be adequately intelligible without any headnote. He accepts, and designates as "census style," the placing of total lines at the top of a table or section rather than at the bottom, but ignores (without even mention as an alternative) an equally important feature of census style, namely, the placing of the most recent

date at the left, close to the stub, in a table presenting columns of data for various years.

The supplementary material is not well arranged or adequately labeled. The changes recommended in the comment on the specimen tables are for the most part improvements, though in some cases they result in presentations quite as illogical as anything in the original table; for example, in the revised stub on pages 52 and 53 the items "A: Total (payable in dollars):" and "B: Total (payable in foreign currencies):" violate several criteria that might be set up, in particular in that the distinguishing element between the two groups is not only put second in position but also placed in parentheses—as no essential part of a designation should ever be.

Throughout, the book mingles specifications for the physical make-up of tables that are to be printed in type and tables to be written on the typewriter for photographic reproduction, whereas one of the first requirements in a set of instructions for this phase of table-making should be a recognition of the fact that two distinct sets of techniques are required for these two methods of printing.

With the exception of a brief generalized preface, the book is confined mainly to statements on specific mechanical points. It is unfortunate that the author did not see fit to devote more time to an opening discussion which would bring the materials into better perspective. In its present form the book reads like a series of items from a notebook carefully kept but not well coordinated, or like a book of exercises designed to test the mastery of a comprehensive volume which unfortunately is not existent. It is replete with sententious phrases, some of which one cannot but admire even though he does not always agree with the import. In short, it may be said of the whole book that, while it is interesting to read and stimulating to one already familiar with current usage in the construction of statistical tables, and while many—yes, even most—of the recommendations with respect to table form are good, there are so many variations from this rule that the book cannot safely be taken as a reliable guide for the inexperienced maker or editor of statistical tables.

LEON E. TRUESDELL

Bureau of the Census

Elementary Statistical Methods, as Applied to Business and Economic Data, by W. A. Neiswanger. New York: The Macmillan Company. 1943. xviii, 740 pp. $4.00.

It is the stated purpose of this volume to serve as a text for a one-semester course in statistics for students of economics and business. The lengthy and wordy approach to the subject involving more than 700 pages of text makes questionable the use of the volume for a one-semester course.

The author's intention was to "emphasize the basic concepts of statistical methods so that certain principles will endure long after details have been

forgotten." While this objective is entirely worthy, especially for courses in which it is intended merely to introduce students to the subject, the resulting emphasis upon broad generalizations may readily defeat the aim by the very vagueness of the generalizations. For instance, the first chapter indicating illustrative uses of statistical analyses in which an attempt is made to describe in a paragraph or two a broad application of statistics, is likely to be misleading. As an example the attempt to describe the War Department supply control statistical procedures in less than one page of text is of doubtful value and not likely to be enlightening in understanding the application of statistical methods to this broad problem.

The treatment of subjects such as the steps in conducting a statistical investigation, the preparation of questionnaires, and graphic presentation is not well organized or systematic.

As might be expected in a volume of this type there is considerable emphasis upon index numbers and methods of their construction and time series analysis. The exposition of these subjects is adequate and the approach systematic. The examination of a considerable number of current index number series lends interest and gives rise to a better understanding of some of the problems of index number construction.

The scope of the volume is usual for the texts of this type, the differences being largely matters of emphasis. The illustrative computations are typical of the application of statistical techniques to broad economic problems rather than problems relating to the individual business enterprise.

The volume is written clearly and lucidly, and since the instructor in a course of the type for which it is intended is at liberty to leave out of the directed readings much of the non-essential materials and can change the emphasis at will, the book will serve as an adequate text when judiciously applied.

Herbert Arkin

College of City of New York
(On leave to U. S. Army)

Elements of Statistical Method, by Albert E. Waugh. New York and London: McGraw-Hill Book Company, Inc. Second Edition. 1943. xxi, 532 pp. $4.00.

This volume is a revision of a book which was first published in 1938. The basic arrangement of the first edition has been maintained in the new edition, but there has been some reorganization and expansion which has resulted in the addition of four new chapters.

The aim of the book, as stated by the author, is to introduce the student to statistical concepts and statistical nomenclature and to get him to think in statistical terms. The book is not planned for the statistician in any particular field. It is also the author's purpose to make clear from time to time that one cannot safely apply statistical methods in any field unless and until he has become a master of that field.

After a short introductory chapter, the book immediately proceeds with the more mathematical approach to the methods of statistics, and covers the more elementary aspects of the meaning of numbers, frequency distributions, measures of central tendency, measures of dispersion, probability, the normal curve, moments, measures of skewness and kurtosis, the Poisson Series, the chi-square test, measures of reliability, secular trend, cyclical movements, index numbers, and linear, curvilinear, and multiple correlation. The main part of the book then closes with two short chapters on tabulation and graphic presentation, and collection and analysis of data. Selected statistical tables and a short bibliography are included in the appendices. Reading suggestions and exercises are included at the ends of the chapters.

While the book is designed to be elementary, the author assumes a good knowledge of college algebra on the part of the reader. In many instances, however, the discussion of methods involves concepts or procedures not ordinarily covered in college algebra.

This book presents an excellent selection, as well as an excellent description, of methods that should be considered by the beginner in statistics. No two teachers naturally will agree upon exactly how a course in statistics should be taught or how a text book should be written. And the problem is more difficult if the course is a general one for students majoring in a number of fields than it is if the course is designed for students in a single specialized field. The outstanding difficulty arises, of course, in explaining the application of the various methods. In the limited time that can be devoted to the study of a certain method, the student often does not grasp its significance thoroughly enough, when applied to a field not his own, to enable him to carry its use over to his own field. The present text, designed as it is to cover a broad field, generously illustrates the methods with examples from many kinds of activities, but it wisely refrains from assuming too much responsibility for teaching intensive application and leaves it to the instructor to coordinate the problems of application with the various interests of his class. The teacher of a general course, therefore, who himself can cover application in his lectures and laboratory work and will also augment the information on tabulation and collection of data, should find this book to be a very satisfactory text for covering the description of methods in elementary statistics.

JOHN R. RIGGLEMAN

Washington, D. C.

Hospitalized Illness in New York City, by Neva R. Deardorff and Marta Fraenkel. New York: Welfare Council of New York City. Hospital Discharge Study, Volume 2. 1943. xvii, 349 pp. $1.00.

This is the second of a series of three volumes which analyze 576,623 discharges from hospitals in New York City in 1933. The study was made by the Research Bureau of the Welfare Council of New York City with the assistance of the state and city work relief authorities and the Works Projects Administration. Volume I, *Hospitals and Hospital Patients in New York City*,

dealt with the general demographic and public health aspects of the study; this volume deals with its medical aspects. Volume III "will extract from the experience of the project practicable ways and means for hospital morbidity reporting as a routine procedure."

The present volume is divided in the main in three sections: obstetrical service (of the total of over a half-million discharges, 23 per cent were of obstetrical patients and newborn); service for acute conditions; and service for chronic conditions. Separate chapters are devoted to the more important specific conditions; and in each, hospitalization for these causes is discussed in relation to a variety of pertinent factors, race, age, and sex of patients, length of stay, type of hospital, and so on. Brief chapters at the end are devoted to convalescent homes and homes for the chronically ill. An appendix section deals with problems peculiar to hospitalization of children and of the aged. There are 108 brief tables and an extremely important extended table showing for each of the general voluntary and municipal hospitals in the study the number and per cent of discharged patients for selected diagnoses.

The data, despite the fact that they are ten years old and that recent medical discoveries may seriously affect hospitalization habits, are of great value. Information on age and sex differences in hospital rates for the different diseases are important to any well planned community program of hospital construction and maintenance. The data show wide differences among hospitals in the proportion of cases of various conditions, a fact which may mitigate against rounded training of interns. They point up the need among hospitals to make uniform the terminology and classification of disease. The data are also useful in that they add confirmation to the findings of other studies, and to commonly held beliefs—for example, that care for many of the patients was necessarily of a custodial character and that care in more appropriate institutions will often serve the patient at least as well as the hospital does and probably at less cost to the community.

The text is very readable, which is unusual in a work of this nature. That the manuscript had to be printed by the offset process, because of "the financial strain on voluntary agencies during these times," will not detract from its usefulness to all persons interested in the hospital field.

ISIDORE ALTMAN

U. S. Public Health Service

Union Rights and Union Duties, by Joel Seidman. New York: Harcourt, Brace and Co. 1943. viii, 238 pp. $2.50.

The growth of union power during the past decade has inevitably raised the question of union responsibility. This book, written from a point of view sympathetic with labor, acknowledges that some unions are guilty of irresponsible and anti-social acts and warns organized labor to put its house in order.

The alternative is government regulation, which, if drastic and ill-designed,

may permanently impair the labor movement. As an example of the extreme measures that may be taken, the author cites the Smith bill, passed by the House of Representatives shortly before the attack on Pearl Harbor. Rather surprisingly, he fails to discuss the restrictive features of the Smith-Connally Act, passed over the President's veto in June 1942.

Some of the abuses of power discussed in this book have been harmful primarily to the unions' own membership or the labor force from which that membership is drawn. These include the denial of union cards to Negroes and certain other groups, excessive entrance fees and dues, undemocratic administration, and financial irresponsibility. Among the chief offenses against employers are strikes and stoppages in violation of contract, jurisdictional disputes, and undue restriction of production. The public is adversely affected by the interruption of public services or the flow of war materials, high prices resulting from unreasonable union activities, and the vicious influence of union racketeering.

Such practices, as the author carefully points out, are rather exceptional, and are most commonly encountered in immature unions and in the racketeering and anti-social fringe of unionism. Moreover, he notes, "in the turbulent and emotionally charged field of industrial relations labor has not been guilty of all the evils and excesses." Management's conduct, however, has been restricted considerably in recent years by effective legislation. "Would not (government) regulation likewise remove the worst union practices, to the gain of the worker, employers, and the general public?"

Even the unions' growing realization of their responsibility, the author believes, can only postpone government regulation. It is not regulation that the unions should fear, however, but regulation proposed or administered in the spirit of anti-unionism. He believes that two measures of governmental control would clearly strengthen the loyalty of union members and are now desirable: (1) the prohibition of unreasonable membership restrictions and (2) provision for the impartial review of disciplinary procedure. Among other proposals discussed favorably, but not recommended for immediate adoption, is the establishment of a governmental board to which employers could appeal for the settlement of jurisdictional disputes.

The discussion of practical methods for increasing union responsibility, appearing in the concluding chapter, is particularly stimulating. This thoughtful and competent volume deserves careful study in connection with any future proposals of regulatory legislation.

ROBERT J. MYERS

U. S. Bureau of Labor Statistics

Cost Behavior and Price Policy, by The Committee on Price Determination. New York: National Bureau of Economic Research. 1943. xix, 353 pp. $3.00.

I hope that nothing that is said in this book review will do other than

encourage statisticians to read the book for themselves. This is especially important because the principal value of the book to them lies in its clarification of particular cost and pricing problems; in its stimulus to further thought and discussion on the nature of costs and their relation to prices; and in its many practical suggestions for further research. This is not to deny the importance of the observations and findings of the survey but rather that in addition to being important in themselves they will be of even greater importance in stimulating further thought, discussion, and research. The book is on the whole a firmly practical springboard for future inquiry.

This is in keeping with the spirit in which the book was written and in accordance with the following statement in the Introduction: "The Committee will be content, therefore, if this report is accepted as an introduction to a body of imperfectly known material, as a critical appraisal of existing studies of cost behavior, and as a presentation of suggestions for further research."

The book is concerned for the most part with the behavior of costs in the individual enterprise and to a lesser degree with the implications of this behavior in the establishment of price policy. The authors do not pretend to have covered all of the cost problems of the individual enterprise nor to have made a complete study of the principal cost problems of such an enterprise. This becoming modesty should not be taken to mean that the survey is superficial. It goes deeply enough for one plowing of the field and provides ample suggestions for deeper investigations of particular problems.

Part One of the book deals with the character of costs as considered in economic theory and in accounting practice, and suggests that neither of these concepts is really satisfactory for the type of research into cost behavior that the authors favor. The authors show restraint and fairness in reviewing economic and accounting concepts of cost but point out that " . . . a great deal remains to be done in the process of translating theoretical structures into statistically measurable concepts, and of expanding accountancy into a more logical and useful system. The present volume is intended as a step in that direction."

Part One also presents "a preliminary examination of some of the complexities in the meaning and measurement of price." Here as elsewhere the practical problems of the businessman as well as the theories of the economist are recognized.

As stated by the authors, "The substance of the volume is represented by the analysis of Part Two. The thread of this analysis, to which the discussion of the various chapters is tied, is a consideration of the problems of isolating the influence of a single variable among the many which simultaneously affect costs. It must be admitted that the thread is a tenuous one, that its frequent breaks are patched up only with difficulty, and that the authors wander on occasion into other fields. Their excuse must be that the material is in many places scanty and that very little systematic work has been done in this area. A common structure is apparent in all the chapters in Part Two

and serves to focus attention upon the principal objectives with which all are concerned: a consideration of the statistical problems involved in the study of the influence of certain factors on costs, a critical evaluation of existing materials and studies, and suggestions of further research possibilities."

Part Two includes an analysis of empirical studies of the relation between variations in output and costs. The studies are of three types, namely "statistically derived cost functions" based on the accounting records of particular companies, "estimated cost functions," that is, " . . . estimates by engineers and accountants, presented as cost functions and focused on past experience," and "cost-revenue charts" (break-even charts) of two types, one based on historical records and the other based on budgets.

The titles of the chapters in Part Two are: Costs and Rate of Output, Prices of Input Factors and Cost Behavior, Technical Change and Costs, Allocation of Costs Among Products, Selling Costs, and Costs and the Size of Plants and Firms.

Part Three deals briefly with the implications of cost behavior for price analysis.

Several studies are presented as appendices because they are of interest in the area of cost behavior but do not tie directly into the body of the report.

In closing I should like to suggest that most of the problems considered in this survey are likewise of concern to the managers of smaller companies in which there are no staff economists or statisticians to interpret the language of such a survey. I hope that the Committee on Price Determination will give serious consideration to the problem as to how information of this type may best be conveyed to such managers.

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Financial Accounting, A Distillation of Experience, by George O. May. New York: The Macmillan Company. 1943. ix, 274 pp. $3.00.

The sub-title of Mr. May's book describes its character. It traces the outstanding controversial theories of accounting as they have developed over the last third of a century, in the light of changing public policies, such as taxation and regulation, and as they have been influenced by marked changes in price levels and industrial activity. This maelstrom of conflicting interests and attitudes of accountants, businessmen, lawyers, and politicians is the basis for his thesis that "The rules of accounting, even more than those of law, are the product of experience rather than of logic." Throughout the book he illustrates this view by pointing out that many of the difficulties accountants face result from attempts to make foresight out of hindsight.

The book is well-organized. In its separate treatment of the problems aris-

ing under the general headings of cost, value, and depreciation of fixed assets; liabilities; and income; Mr. May has developed the antagonistic premises of the conflicting accounting doctrines that are advocated for the solution of the various problems involved. His thesis that the accounting rules to be applied depend upon the purpose the accounting is to serve is well made. The book brings out clearly the great difficulty modern corporations face in attempting to prepare income statements and balance sheets that adequately set forth the important facts of prime interest to their stockholders.

The book should be required reading for all those aggressive, socially minded spirits who attempt to reinforce their arguments for drastic legislation by naive calculations based on simple aggregates of corporate accounting statements. The book should also be required study on the part of all public officials having to do with the financial policy of corporations.

There is one curious omission from the book that deserves comment. Mr. May does not adequately explore, in this reviewer's judgment, the theory of valuation based on "replacement cost" (as distinguished from the theory of "reproduction cost"). "Replacement cost" is the most realistic approach to the valuation of fixed assets in a world in which those values are undergoing constant change due to technological developments. Regardless of accounting theory, most of the decisions of businessmen as they affect the purchase of such assets are based upon replacement cost. This will be the central point of controversy in the period ahead in connection with the disposal of the enormous quantity of fixed assets which the Federal Government has acquired for war production.

STEPHEN M. DUBRUL

The New Philosophy of Public Debt, by Harold G. Moulton. Washington: The Brookings Institution. 1943. vi, 92 pp. $1.00.

This brilliantly written and closely argued pamphlet restates in a popular fashion the conservative (classical) point of view with regard to a huge and growing public debt. With a keen dialectical ability, the position of the heterodox New Philosophy—which is in reality in no sense a new one—is analyzed. The polemics is directed primarily against Professor Alvin Hansen, with occasional salvos fired at Mr. A. A. Berle, Jr., Professor Seymour Harris, and the defunct National Resources Planning Board. The main approach of the author consists in refuting, so far as his space permits it, the arguments current at present in favor of a "permanent" public deficit: that our economy has become mature, unable to produce progress unless aided by income-creating (net) government expenditures; that a permanent excess of savings exists, to the detriment of new investments; that the excessive liquidity of corporations eliminates the demand for capital on the open market, leaving a gap to be filled by government borrowing; that an internal debt is no debt at all ("we owe it to ourselves"); that credit expansion for public purposes is just as "productive" as that on business accounts;

and that inflation can be controlled without resort to totalitarian regimentation.

Dr. Moulton's approach is polemical throughout, with emphasis on the lack of precision and consistency of his opponents, a task that is made particularly difficult by the technique of literary "hedging" in which Professor Hansen excels. But with all its merits in lucidly presenting, within a short compass, the ramifications of a profoundly comprehensive topic, this pamphlet leaves the reader without effective guidance. In the first place, essential problems involved are altogether neglected in Dr. Moulton's analysis, as they are in that of his opponents. The inflation problem, e.g., is discussed as if it were merely a matter of balancing the budget, omitting to give as much as a passing hint to the consequences which the accumulation of vast holdings of liquid savings may entail. Just as his adversaries do, Dr. Moulton argues about the size of the debt, without regard to its composition: both sides seem to ignore the very significant (monetary) difference between short and long maturities. Nor is much attention paid by either side to the fact that a systematic pump-priming monetary policy amounts in effect to the permanence of governmental subsidy distributions, with far-reaching effects on competition, industrial progress, economic and political "equilibrium," etc.

Secondly, Dr. Moulton gets into "deep water" by attacking the theory that wealth can be created by the creation of government debt. The irony of the situation is that representatives of that theory, such as Mr. Berle, use Dr. Moulton's authority on its behalf. Indeed, it was our author himself who, some twenty-five years ago, revived John Law's thesis that the granting of credit for the proper purpose is a process of wealth-creation. If that were true, if long-term credits extended by banks to industrial firms are "productive," why shouldn't the same credits, originating from the same banks—even though through the purchase of government bonds, the proceeds of which are used for the identical purpose—do the same trick? There are many examples available to show that governmental credit institutions can finance ventures of a "self-liquidating" nature, in the Moultonian sense, just as banking houses do. Dr. Moulton is caught in his own line of reasoning. Obviously, his own theoretical chickens came home to roost, so to speak, leaving one of his principal arguments against the continuation of governmental deficits without logical foundation. But his lucid and incisive criticism of numerous other inflationary reasonings gives this little book a distinguished place in the current discussion of our basic financial problem.

MELCHIOR PALYI

Chicago, Illinois

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McDougall, John L. *Railway Wage Rates, Employment and Pay.* Toronto: Longmans, Green & Company. 1944. 34 pp. 50 cents.

* Annual reports and publications presenting statistics collected at regular intervals have been omitted from this list. Some items of minor interest to statisticians have also been omitted. The contents of periodical publications are not listed, but the attention of the reader is directed to the lists of articles in current publications which are to be found in the *Revue de l'Institut International de Statistique, Journal of the Royal Statistical Society, American Economic Review, Population Index, Transactions of the Actuarial Society of America, The Record of the American Institute of Actuaries,* and *Sankhyā The Indian Journal of Statistics.*—Editor.

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Vratzian, Simon. *Armenia and the Armenian Question.* Boston: Hairenik Publishing Company. 1943. ix, 107 pp.

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